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FINAL REPORT

NSF Advisory Committee on Merit Review

1986

National Science Foundation, Washington, D.C. 20550

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NSF DIRECTOR'S STATEMENT ON THE
REPORT OF THE ADVISORY COMMITTEE ON MERIT REVIEW

In April 1985, acting on a recommendation of the National Science Board Committee on Excellence, I appointed an Advisory Committee on Merit Review, chaired by Dr. Norman Hackerman. I asked that it examine competitive review procedures at the National Science Foundation and at other Federal agencies and recommend changes and improvements, if appropriate.

RATIONALE:

The rapidly changing research environment and increased pressures on the review system suggested the need for a special committee of distinguished outside evaluators to examine Federal agency peer review procedures with an in-depth review of the system, focusing on the National Science Foundation.

THE MERIT REVIEW SYSTEM

Since its establishment, the National Science Foundation has relied on the judgment of qualified, experienced scientists and engineers to select the most promising high quality research for support. This system has been subjected to periodic examination by internal task forces and outside panels, including Congressional Committees. It has been found to be remarkably effective and flexible, adapting to the changing needs of science and engineering research, and incorporating improvements with respect to openness, accountability, equity, and impact on the research environment.

As the core of the decision-making system that provides support to researchers at universities across the range of scientific disciplines, the competitive merit review system has served as a barometer -- and even a lightning rod -- of change in the research system. The expansion of research opportunities and steady growth in the number of high caliber research proposals have sharply increased the competitive pressure on the resources available to support research and the research infrastructure. This in turn, has increased pressure on the merit review system.

NSF recognizes that shortfalls in support for academic science and engineering research facilities have led to pressures on the competitive merit review system. This situation has in some instances led to activities that bypass the merit review system. The Advisory Committee's report emphasizes that the existence of this situation does not imply unsoundness in the review system itself. Rather, the report strongly reaffirms the fundamental health of the present system. The Foundation does not agree with suggestions in the report that additional review mechanisms are needed or would be efficacious in addressing the problem of bypassing merit review.

NSF TASK FORCE

A task force chaired by NSF's Senior Science Advisor, Dr. Mary Clutter, was charged with the responsibility to undertake a careful review of the Committee's conclusions and recommendations and to develop an action plan for the Foundation. The action plan that follows is based on that review.

ACTION PLAN

The task force has aggregated the Advisory Committee's recommendations into an action plan consisting of five categories. I have reviewed the plan and intend to implement it immediately.

SELECTION CRITERIA: NSF's primary criteria for selection of research projects have always been the quality of the proposed research and the competence of the investigators. Once excellence has been established secondary criteria are applied. Specifically, attention is given to the effect of the project on the research infrastructure, and to contributions to related goals of equity and distribution of resources among institutions and geographic areas. The changing scale and organization of science have increased the importance of these factors and of multiple elements in the evaluation of a proposal. This is especially true for center-based activities, research groups and shared facilities.

1. The Advisory Committee recognized the evolution of the peer review process and recommended adopting the term Merit Review to describe the selection process. (II-1)

> Action: Merit Review is a more accurate description of the review process employed at NSF. The recommendation of the Committee to adopt its use will be implemented, and top level management will insure compliance in application of the extended criteria to appropriate programs and proposals.

2. Multidisciplinary proposals and other large projects require different evaluation procedures from those normally used for single investigator proposals. (II-5)

> Action: NSF has developed review procedures such as the use of multi-stage review panels to handle evaluation of large projects, for example, Engineering Research Centers. These procedures need to be codified and will be applied to other large project proposals, as appropriate.

3. The Committee also addressed the evaluation of standard proposals that are interdisciplinary or fall between internal organizational units. (II-6)

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Action: Interdisciplinary panels, as currently used in programs such as the Chemistry of Life Processes, will be considered for other new and rapidly evolving interdisciplinary research areas.

Action: Unsolicited interdisciplinary research proposals from individual investigators that do not fall readily into established program areas occasionally present review problems. An ad hoc task group is currently formulating recommendations for the processing and review of such proposals.

4. The fairness of the review process is of prime importance. This can only be assured if reviewers and review panels reflect the broad community of excellent scientists and engineers from academia, government, and industry. (II-7)

Action: The Foundation has in place specific guidelines for the inclusion of women and minority scientists or engineers and individuals from predominantly undergraduate institutions in the review process including participation on review panels and advisory committees. Management will follow up to insure that practice at the program level is in full compliance with these guidelines.

Creativity and Risk: The support of excellence in research must include receptivity to creative, high-risk research. NSF has always encouraged its program officers to support such proposals. (II-9)

Action: NSF will encourage program managers to make greater use of discretionary authority to identify and support creative, high-risk proposals. Special allocation of funds will be considered pending evaluation of a current experimental program.

Action: Oversight review committees and disciplinary advisory committees will be instructed to identify and examine creative high-risk proposals, both funded and declined, and to report the extent to which they are given appropriate consideration.

Data Bases: Effective monitoring of the review process by Management rests on the adequacy of the information available on it. NSF data bases have been constructed to include information on proposal submission and awards and on reviewers and advisory committee members by sex, age, institutional affiliation, minority group and disabled/handicapped status. (II-2)

Action: Procedures will be established to facilitate periodic management review of the accuracy and completeness of existing data bases and specifically to determine if the existing data bases need to be improved or expanded.

Action: At the conclusion of each fiscal year, a report will be prepared summarizing the attributes of the proposers and reviewers, providing insight into the changes in the reviewer and proposer pools over time.

Responsiveness: The equity and accountability of the review process relies in good measure on its transparency and timeliness, and its responsiveness to the needs of the research community. (II-3,4)

1. Feedback to Reviewers
   Action: Responsible reviewers willing to provide their expertise on a repeated basis are the core of the review process. NSF will provide feedback to them by sending them a list of all awards made in disciplinary areas they reviewed at the conclusion of each fiscal year.

2. Reviewer Responsibility
   Action: Reviewers bear a responsibility to render a balanced judgment, free of bias and vituperation. Incomplete review and intemperate or personal remarks are unacceptable and will not be used in the selection process. Futhermore, principal investigators will be notified that such reviews were not used and given an explanation. Finally, extensive education of the reviewer community to NSF's requirements will be undertaken.

3. Timeliness
   Action: NSF will accentuate its efforts to reduce proposal processing time within flexible parameters that acknowledge the special demands of complex proposals. For the majority of proposals, the current goal of six months will remain in effect.

Infrastructure: The increasing need to improve the infrastructure of science and engineering has concomitantly increased competitive pressure for resources available for support.

1. Facilities - Pressure is particularly acute in areas where federal investment has decreased over the past 20 years, namely in the support of facilities construction and renovation. The appropriate federal role with regard to facilities support remains to be determined and the Foundation will continue to cooperate with this effort. (II-8)

   Action: NSF is mandated to provide on a biennial basis, the database on facilities to the Congress. The first report has now been released, and should prove helpful in defining the appropriate federal role in support of facilities.

In addition, NSF has in place a mechanism to respond to facilities needs within the context of research proposals. On September 27, 1985 an Important Notice was released to the entire university and college research community clarifying the Foundation's policy on construction and renovation of research and education facilities.

2. Capacity Building - The Advisory Committee recommended the adoption of long term preferential programs to improve the science and engineering base throughout the U.S. and was concerned about equitable review. NSF has in place a number of capacity-building programs, for example, Experimental Program to Stimulate Competitive Research (EPSCOR), Minority Research Initiation (MRI), College Science Instrumentation Program (CSIP). Special review procedures insure equitable treatment. (II-7)

> Action: NSF will review all capacity building programs and establish evaluation criteria to monitor effectiveness and progress towards the ultimate goal of mainstreaming such activities.

CONCLUSION

The Advisory Committee on Merit Review is to be commended on the successful completion of its challenging assignment. The recommendations of the Committee that frame the agenda for future action are an important contribution to our continued efforts to enhance the effectiveness of NSF's review procedures. As the Advisory Committee's report points out, the dynamism and flexibility of the competitive merit review system have been critical elements of its success. It must remain receptive to change and improvement in the future if it is to continue to serve the needs of the Nation.

Erich Bloch
December 17, 1986

September 25, 1986

Mr. Erich Bloch, Director
National Science Foundation
Washington, D.C. 20550

Dear Erich:

I am pleased to transmit to you the final report of your Advisory Committee on Merit Review.

Our mandate was broad, and the subject complex. Accordingly, we set our focus at three levels.

First, and most important, the report defines the concept of merit review, describes the process as practiced in different Federal agencies and programs, and offers an historical explanation concerning the evolution from "peer" review to the more comprehensive merit review process.

Second, it examines review processes in several NSF program areas in which the criteria for project selection include both technical excellence as well as non-technical concerns such as building research infrastructure or the likelihood of useful applications. Model review processes for different kinds of objectives are identified, and recommendations are made.

Finally, it examines in detail several issues in carrying out the two principal forms of project review at NSF -- the ad hoc mail review, and the panel review processes. The role of the program manager and problems of accountability are also discussed. Several improvements are recommended.

The report was adopted by the Committee without dissent. The Committee thinks the report is informative, and believes it will be useful to you, the science and engineering communities, and science policy makers.

Sincerely,

Norman Hackerman, Chairman
Advisory Committee on
Merit Review

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National Science Foundation, Washington, D.C. 20550

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The Committee expresses its appreciation to Dr. William Carey who made available the excellent A.A.A.S. facilities for two committee meetings.

PREFACE

Committee Background and Charge

In 1985 the National Science Board issued a report by its Committee on Excellence in Science and Engineering on the problem of direct Congressional funding of academic research facilities, by-passing the merit review system. One of its three recommendations was that the NSF Director should appoint a committee to examine project selection procedures within the National Science Foundation, survey other agencies' approaches, and recommend modifications of procedures if appropriate.

In response the NSF director appointed an 11 member Advisory Committee on Merit Review in April 1985. The charge to the Committee read as follows:

"Purpose and Functions

A. Purpose: The Advisory Committee on Merit Review will evaluate merit review as practised by NSF and other agencies and provide its advice and recommendations concerning alternative systems of merit review and selection of projects for grants.

B. Functions: The principal functions of this Committee are to:

1. Document present methods of merit review at NSF and other appropriate agencies. This includes both peer review, per se, as well as selection criteria used in decision-making.
2. Evaluate differences between the implementation of merit review among NSF directorates.
3. Analyze how merit review applies to diverse activities, such as general research grants, instrumentation awards, facilities, and special programs (e.g., international, women, and minority programs).
4. Assess inequities that may result from merit review, such as underrepresentation of certain institutions or constituencies.
5. Identify the strengths and shortcomings of present procedures.
6. Make recommendations for overcoming limitations of the present methods of merit review.
7. Prepare reports of its activities as appropriate."

The Committee met five times -- in July, October and November 1985 and February and July 1986. It heard presentations from all the NSF directorates, from representatives of major Federal research supporting agencies (DoD, NIH, DoE and USDA), and from staff of the House Subcommittee on Science, Research and Technology. The Committee also received and considered correspondence from a variety of interested parties.

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I. EXECUTIVE SUMMARY AND CONCLUSIONS

1. Overall Assessment (See III and VI A, below)

Technical (peer) review is a cornerstone of Federal agency arrangements for research project selection. The Committee found that by and large the system is functioning well. No evidence was found that standards of technical excellence were being compromised in the review processes of the various Federal agencies, including the National Science Foundation, although improvements are possible and desirable.

For an increasing proportion of Federally sponsored research, however, technical excellence is a necessary but not fully sufficient criterion for research funding. To reach goals such as increasing the practical relevance of research results, or improving the nation's infrastructure for science and engineering, additional criteria are needed. The wide range of mechanisms evolved by Federal agencies for utilizing such additional criteria is impressive. The Committee has adopted the term "merit review" to refer to selection processes which include technical as well as these additional considerations. The Committee's discussion focusses both on narrower issues for improvement of technical (peer) review as well as on broader merit considerations.

2. Improving the Process and Quality of Review (See VI B below)

a) Reviewer Pool (See VI B1, below)

NSF's reviewer pool is too large and diverse to warrant charges of elitism or in-group exclusiveness. Nevertheless, a number of important issues need to be addressed. How reviewers get into the pool, how long they stay, how often they are requested to review, how often they decline to review, are all important questions that can only be addressed anecdotally at present. The Committee recommends a serious effort to develop data covering these issues.

b) Promptness (See VI B2, below)

While increasing program manager discretion will speed some proposal decisions, measures to improve merit consideration of proposals may increase proposal processing time for others. Continued efforts should be made to reduce further administrative processing time for proposals. The Committee encourages NSF to strive for its current goal which is six months maximum processing time.

c) Quality of Mail Reviews (See VI B3, below)

The review process can be no stronger than the willingness of the community to participate in it with vigor and integrity. Anecdotes suggest that poor quality reviews -- sometimes perfunctory, sometimes intemperate -- do occur. The Committee recommends that the language of NSF's instructions to reviewers be revised to include requests for full coverage and moderate language. The extent of irresponsible reviewer behavior should also be examined, and program managers should be given every support possible to help them select the best reviewers.

The Committee also recommends that means be explored to provide reviewers with some kind of feedback on their contributions, such as sending them the annual listing of program awards.

d) Panel versus Ad Hoc Mail Review (See VI B4, below)

Non-scientists, and even scientists and engineers themselves, find the parallel existence of two basic forms of project review puzzling. The Committee recognizes that each basic type of review is rooted in the traditions of different research communities, and that each has certain strengths and vulnerabilities. No strong preference was expressed for either model. Perhaps, like corn, well thought out and nurtured hybrid varieties promise the most vigorous yields for the future.

e) Conflict of Interests (See VI B5, below)

Some conflict of interests is inherent in any process of review by peers. The Committee believes, however, that NSF's current policies on conflict of interest are adequate to minimize bias in project selection that might derive from conflicts of interests.

3. Merit Review and the Evaluation of the Extrinsic Utility of Research (See VI C, below)

The Federal mission agencies have well tried procedures for selecting research work relating to their missions. NSF has been experimenting, with mixed success, over the past 15 years with various mechanisms for relating research to national needs.

The Committee applauds NSF's current strategy of increasing research infrastructure investments in selected areas of national need through merit review processes. Overlapping technical (peer) and relevance panels, like the ones used in choosing NSF's Engineering Research Centers, provide a model review procedure for large projects and centers intended to have an impact beyond the advancement of knowledge itself.

4. Review of Inter- and Multi-disciplinary Research (IMR) Proposals (See VI D, below)

To deal with IMR proposals no one has yet devised a substitute for ad hoc groups of reviewers whose expertise spans the multiple perspectives and skills required. Panels are frequently a necessary part of the process, and individuals who have penetrated disciplinary boundaries can play a crucial role. Further, the Committee stresses the critical role of high quality program staff in this area. Particularly important is their openness to exploratory inquiries from the field, and their willingness to take the trouble to negotiate joint funding arrangements with other related programs. NSF's within- and cross-Directorate IMR programs provide models of how such proposals can effectively be handled.

5. Merit Review and Improving the Infrastructure of Academic Science and Engineering (See VI E, below)

a) The need for strong management commitment (See VI E1, below)

Infrastructure and capacity building are long term concerns which require strong leadership and management commitment to framing and fulfilling long range plans. Top management must periodically reaffirm the goals and must ascertain that all the relevant review criteria for project selection are in fact being utilized. This requires the creation and use of information bases about the review process.

b) Minorities, women and the handicapped (See VI E2, below)

The effort to utilize all available science and engineering talent is a matter of national need as well as equity. Set-aside programs to bring underutilized groups into science and engineering serve an important transitional role. But the long term goal is for members of such groups to succeed in general competition. There is a danger that set-aside programs will fail to move collective capacities far enough, or to encourage individuals to achieve at a level consistent with their capacities. The Committee recommends that NSF aim to supersede set-aside programs for underutilized groups with a preferential strategy. At the same time, adequate information must be generated to track and assure application of appropriate review criteria, and use of appropriate mix of reviewers.

c) Geographical distribution (See VI E3, below)

After examining the available data the Committee was convinced that the geographical distribution of NSF research funds is roughly proportional to the current distribution of research related resources in the states and regions. To build national research capacity, however, areas which now have limited resources must be targeted for infrastructure improvement. The Committee applauds NSF's EPSCOR program (Experimental Program to Stimulate Competitive Research), and its merit review process, as an example of the kind of capacity-building effort which is likely to be successful in this and other areas of infrastructure.

d) Baccalaureate Institutions (See VI E4, below)

The role of non-doctoral institutions in identifying and nurturing science and engineering talent is critical. These schools graduate over one third of all bachelors degree recipients who go on to earn science and engineering doctoral degrees. They also provide a significant portion of the bachelors and master degree graduates in science and engineering who go directly into the labor force. Targeting and capacity building strategies should be vigorously pursued to strengthen this sector of academic science and engineering, and measures should be taken to assure appropriate weighting of review criteria in the awarding of grants.

e) Selection Process for Awarding Academic Science and Engineering Facilities (See VI E5, below)

The Committee is concerned about the increasing frequency of awards of funds for academic research facilities by direct Congressional action, independent of agency planning and review processes. It believes that, in the absence of regularly budgeted agency programs for facilities, unmet needs are driving universities to seek facilities from any available source, including directly through their Congressional representatives.

The Committee believes the Federal government has a responsibility to share in the costs of research facilities, and believes that in the long run, programs to provide such support are indispensable for the vitality of the Nation's science and engineering enterprise. By establishing such programs, Congress would authorize funding agencies to design appropriate merit review processes for facilities. The Committee recommends that NSF urge that the process of determining Federal reponsibilities in this area be rapidly completed.

Until such programs are in effect, however, a process is needed through which members of Congress can obtain independent technical (peer) assessment of proposed science and engineering facilities which are intended to enhance the national infrastructure for academic research. Such advice needs to be obtained before the items are included in agency appropriations.

6. Program Manager Discretion (See VI F, below)

The Committee wishes to stress that high quality program managers are critical to the operation of the merit review process. Good program managers are the key in several situations covered in these recommendations: in managing technical (peer) review, especially in the case of multi- and interdisciplinary research proposals; in making appropriate arrangements for including research planning and infrastructure considerations in the review process; and in providing for the inclusion of relevance and utility criteria in the decision process.

Furthermore, the ability of program managers to sense the potential, as well as the current state, of their fields is important in the support of innovative research. The Committee recommends that there should be continued consideration of arrangements to permit program managers increased discretion over a portion of their budgets (5-10%) to support or renew support for creative and high risk research proposals.

7. Accountability in the Review Process (See VI G, below)

The need for accountability in the allocation of public resources creates tensions with the need to depend on the research community for confidential expert advice in the review process. This tension attracts bureaucratic solutions, including increases in required procedures, documentation, and rules on disclosure and audit.

The Committee believes that increasing the overlay of bureaucratic procedures is no solution to the problems of accountability in the review and project selection process. What is needed instead are informality, flexibility, and the capacity to make subtle distinctions which stand on the reputations, credibility, and professional integrity of program officials and reviewers alike. The Committee affirms that this is the kind of response needed from funding agencies to support and propel the discovery process in basic science and engineering research.

II. RECOMMENDATIONS

1. The Committee recommends that the term "Merit Review" be adopted to refer to processes of review, rating and recommendation of proposed science and engineering research and education projects in which the selection criteria include not only technical excellence but also additional factors such as improving science and engineering infrastructure, or practical relevance of the research.
(See Sections I-1 and V)

2. The Committee is concerned about the inadequacy of the data for tracking the processes of merit review at NSF. It recommends improvement of the data system to enable management to answer key questions about the functioning of the process, and to provide improved support for program managers in obtaining the best reviewers.
(See Sections I-2a, VI-B1 and VI-G)

3. The Committee encourages NSF to strive to meet its current goal of reducing proposal processing time to a maximum of six months from proposal submission to final decision.
(See Sections I-2b and VI-B2)

4. In the interest of improving the quality of mail reviews, the Committee recommends that NSF's instructions to reviewers be revised to include requests for full coverage of the proposal and for moderate language. Also recommended is the exploration of means to provide reviewers with feedback on their contributions, such as sending them the annual listing of awards in the program for which they have reviewed. (See Sections I-2c and VI-B3)

5. The Committee recommends as a model for the review and selection of large science and engineering research and education projects and centers, intended to have an impact beyond the advancement of knowledge itself, the overlapping technical and relevance panels as used in NSF's Engineering Research Center program.
(See Sections I-3 and VI-C)

6. As models for handling the review and selection of inter- and multi-disciplinary (IMR) research proposals, the Committee recommends NSF's recently instituted within-Directorate (Engineering) and cross-Directorate (Chemistry of Life Processes) programs.
(See Sections I-4 and VI-D)

7. With regard to programs designed to improve the infrastructure of U.S. science and engineering, the Committee recommends the adoption of long-term, preferential capacity building programs, affirmed by strong top management commitment, and backed by data bases about the merit review processes which can document equitable treatment of proposals. (See Sections I-5 and VI-E)

8. The Committee recognizes that Congress has initiated steps to determine the extent of needs and the appropriate Federal role in the support of facilities for academic science and engineering research. The Committee recommends that the NSF urge that the process of determining Federal responsibilities in this area be rapidly completed. (See Sections I-5e and VI-E5)

9. The Committee recommends that NSF program officers be encouraged to continue present efforts to support creative, high-risk research, and that they be given discretion over a portion of their budgets (e.g.,5-10%) to accomplish this. (See Sections I-6 and VI-F)

III. INTRODUCTION

From the earliest days of Federal support for science, research funding agencies have had to be selective in the award of funds. A major task of the program manager has therefore always been to search for excellence. To aid in that search, the program manager has traditionally used advisers, trusted for their competence and judgment about the scientific promise and technical merit of proposed work as well as the qualifications of the proposing investigator. In the early days of the National Science Foundation, this review process was quite fluid: the first set of NSF grants went from proposal to approval by the National Science Board in two months, including several levels of review.

But times and circumstances change. The environment for peer review has shifted significantly, as described below in Section III. There are new pressures stemming from shifts in the structure of science and engineering research, and from changes in the social and political environment. Peer review is now being applied to a much wider range of selection situations, sometimes with potential technology applications as well. At the extreme there are very large facilities which could by themselves consume half of the total Federal funds for academic research for a single year. The traditional concept of peer review, as assessment of scientific excellence of individual research projects by peers in the same or adjacent fields, is too simple to describe the current diversity and complexity of the project selection system.

Technical review by peers remains, as it has been for four decades, the cornerstone of the project selection system. Under present circumstances, however, non-technical policy considerations often become attached to research funding decisions, especially when these involve program support or facilities. When this happens, the public, and the research community itself, may come to confuse the technical and non-technical aspects of funding decisions. The credibility of technical (that is, peer) review, and ultimately of science itself, is thereby weakened.

The Committee found it important in its work to distinguish clearly between procedures for technical review and the means for incorporating other, non-technical considerations into the decision process. The Committee adopted the term "merit review" for describing both of these processes together. Section V below describes some existing merit review procedures, and Section VI discusses issues and appropriate procedures for some particularly important types of funding decisions.

The Committee believes that the procedures used to select research projects in Federal Agencies are generally functioning well. Tight resources, of course, enhance strains in any system. Under the current funding situation many good proposals remain unfunded, and it is widely believed that there is reduced willingness to fund risky proposals with high potential. But not all the discontent with the process of project selection can be attributed to shortage of funds. Other complaints can and should be addressed with improvements. Some are suggested in Section VI B below.

IV. CHANGES IN THE U.S. SCIENCE & ENGINEERING SYSTEM

A. The Social and Political Environment of Science & Engineering

The growth of U.S. R&D, the expansion of the academic research system, and the Federal role in these developments are quite well known. For the purposes of this report it is useful to distinguish four periods:

- The spectacular contributions of science and technology to the war effort in the 1940's, and the astute activities of a few senior statesmen of science, led to a Federal commitment to assume major responsibility for basic research support. The NIH and the NSF were established, and project selection by technical peer and peer panel review became a cornerstone of the system.
- The rapid growth of higher education in the 1950's and 1960's greatly expanded academic research capacity, which in turn was fueled by fast growing Federal expenditures -- not only for project research, but also for research facilities and scientific and technical manpower growth programs.
- From the late 1960's to the mid 1970's there was a slow-down in the rate of expansion of Federal funds for academic R&D (in constant dollars, there was a slight decline). New Federal R&D priorities arose in the form of new agencies and programs for applied civilian research in problems of energy supply, environmental pollution, and continued growth of health related research. Despite worries about the "steady state university", academic research communities continued to grow, albeit at a reduced rate.
- The current decade has again seen significant shifts in Federal R&D priorities. The importance of basic research has been reaffirmed, but in a changed context which gives greater emphasis than before to its linkages with the development of key national needs for defense and for economic competitiveness.

The linkages of the disciplines constituting basic research to technologies are manyfold and not always obvious. They can be likened to a fluid drive transmission where vigorous activity in one sphere is variably transmitted to another.

The relationship of new technology to economic growth, on the other hand, may be more analogous to a mechanical system of cogs and gears. However this may be, concern with these issues has renewed the interest of policy makers in R&D program design and evaluation, and in project selection mechanisms. Technical (peer) review is seen as a necessary, but for some purposes, not sufficient component of the project selection process.

In the current period, major pressures upon Federal resources require difficult allocation decisions. While academic R&D has fared comparatively well in recent Federal budgets, restrictions are coming at a time when academic science and engineering research is particularly vulnerable. The demographics of student enrollments for the rest of the century is not positive. Student interest in science majors at both undergraduate and graduate levels is not encouraging. Shortages of faculty in several areas of science and engineering may become exacerbated as retirements of the boom faculty of the mid-century pick up. Critical needs are expressed for capital investment in R&D facilities, in part due to deterioration and obsolescence of the capital stock built during the expansion period of the 1960's, and in part due to escalating costs of the "sophistication factor" in frontier research equipment and special facilities. In most fields it costs orders of magnitude more, in constant dollars, to operate at the frontiers of research today as compared with four decades ago.

Another key pressure on basic science is the increasing demand that it serve other public functions. While the obligation of the Federal government to provide major support for basic research has become firmly established, the past decade has seen increasing concern among policy makers with improving the relevance of basic research to key national needs. This has, of course, generally been true for the basic research supported by Federal mission agencies. But it is important to recognize that it has also gradually become part of NSF's mission.

1. How "Relevance" Criteria became part of NSF's Mission

In 1968, in response to Administration and Congressional concerns about the acute needs for new technological solutions to many large and serious problems affecting society, NSF began a series of experimental programs aimed at improving the relevance of basic research to national needs. First, Congress amended NSF's enabling legislation to include "applied research", in addition to "basic research" as an agency goal. NSF followed up in 1969 with a new program -- IRRPOS (Interdisciplinary Research Relevant to Problems of Our Society). This was replaced in 1971 by a much more comprehensive program -- the RANN (Research Applied to National Needs) Directorate which, in the language of NSF's budget proposal for FY 1978, "focusses U.S. scientific and technical resources on selected problems of national importance for the purpose of contributing to their timely, practical solution."

Other strategies were devised in the early and mid-1970's. Notable examples are the NSF's programs for industry/university cooperative research centers and industry/university cooperative research projects, and the small business innovation research program. By 1978, however, it was felt that the problem-focussed approach of RANN was inadequate, and that increased general support for research in engineering and applied science would better strengthen the nation's capacity to create new technologies. Accordingly, RANN was dissolved and in 1979 NSF's Engineering Division was raised to the status of a Directorate. This was done in part as an alternative to the proposed creation of a National Technology Foundation which would have removed Engineering from NSF entirely, and weakened the links between basic science and engineering.

The most recent NSF response to improving the relevance of science and engineering research and education to national needs is the Engineering Research Centers (ERC) program. In contrast to the RANN approach to focus on specific selected problems and technologies, the ERC's represent an infrastructure development approach, to provide resources and opportunities for academic engineering to develop new bases for research and education in collaboration with industry.

Not only has NSF created separate programs for these purposes, but in the mid-1970's it incorporated in its project selection process an explicit selection criterion which asks reviewers of proposals to consider, "the utility or relevance of the [proposed] research ... to the achievement of a goal that is extrinsic ... to that of the research field itself, and thereby [may] serve as the basis for new or improved technology or assist in the solution of social problems."

Of course, changing the criteria for selection without explicitly altering the composition of reviewer groups will not necessarily result in effective application of the utility criterion. Reviewers selected for their familiarity with technical aspects of a proposal are not necessarily best equipped to make judgments about the potential utility of the research, or its impact upon the infrastructure of the science and engineering system. Most of the NSF programs that have explicit utility and/or infrastructure goals in addition to research goals are also explicit about including reviewers with expertise or experience pertinent to those goals in their review processes. Engineering programs, for example, have long used industrial reviewers as a matter of course, and the project selection system in NSF's former RANN Directorate explicitly included representatives of potential "user communities" in its review process.

B. Changes in the Structure of Science & Engineering

Four key changes in the structure of U.S. science and engineering are creating pressures upon the peer review system for project selection.

o The sheer growth in the size of the research community has forced standardization of proposal machinery for managing the system. This is most true for the agencies required to maintain an "open window" -- NIH and NSF -- where, with few exceptions, all proposals must undergo review.

The growth of the academic research community during a period of declining (1967-1976),or more or less steady state, (1976-present) resources, coupled with escalating capital and equipment costs of research is putting severe competitive pressures on the project selection mechanism. Project selection processes suitable in periods of expansion are not necessarily optimal during periods of static or declining resources.

o While convincing supportive evidence is hard to obtain, it is widely believed that science is increasingly moving from "little" to "bigger" science. Review of large project proposals, involving multiple investigators, large equipment or facilities and multi-year commitments, is considerably more complex than review of single-investigator, "small" projects. Large projects may involve significant policy issues concerning matters of research infrastructure (shifts in the distribution of research resources between regions, types of institutions and the like), as well as concerns about economic impacts, which go beyond purely technical considerations.

The trend toward "bigger" and more collaborative or collective research is being driven by two major structural features which themselves are linked: the increasing capital costs of research, and the increasingly inter- and multi-disciplinary character of much science and engineering work.

o Frontier scientific instrumentation and facilities are moving targets -- they are constantly improving, opening up whole new areas of phenomena for investigation. Without access to these tools investigators are excluded from areas of study, and scientific progress is slowed. Complex, expensive research equipment and facilities may actually decrease the cost per unit of scientific information because of their enormously enhanced sensitivity or processing capabilities. Nevertheless, the price to stay at the leading edge of research appears to have been increasing exponentially.

The construction cost of leading edge facilities in particle physics gives an idea of the problem: in 1950 the Berkeley Cyclotron cost about $10 million ($16M in 1972 constant dollars); in 1970 Fermilab cost about $100 million ($110 million in 1972 dollars); and, if it is constructed in 1990, the cost of the Superconducting Supercollider (SSC) is estimated at about $4 billion (nearly $2 billion in 1972 constant dollars). In another example, a 1980 study by the Association of American Universities, The Scientific Instrumentation Needs of Research Universities, reported the actual start-up instrumentation costs for two new faculty members in synthetic organic chemistry in 1970 and 1979. Their personal laboratory equipment costs rose at a rate of 30% annually in constant 1972 dollars, and the cost of the larger, more expensive, departmental equipment to which access was required went up 36% per year in 1972 dollars.

In both "big" and "little" science, then, decisions about the allocation of these resources become increasingly subject to policy and planning considerations, in addition to the criterion of scientific excellence. The review process must take this into account.

o Another structural trend with serious implications for project selection is the emergence of new areas of investigation which have an inter- or multi-disciplinary character. We are seeing emerging aggregations into transdisciplinary and even transprofessional groupings such as "scientist/engineer", and "science/medicine/engineering". Once again it becomes apparent that review and selection processes appropriate to single investigators in single disciplines must be adapted to these more complex and changing circumstances.

V. MERIT REVIEW PROCEDURES

Although the procedures for utilizing expert opinions vary widely, the judgment of scientific excellence lies at the heart of the funding decision procedures of every research-sponsoring agency. But since scientific excellence is often a necessary but not fully sufficient condition for funding, the selection process also includes elements which bring in criteria other than technical excellence. Even in the early days of NSF, for instance, advisory panels assisted the program manager in selecting a portfolio of projects which reflected the broad interests of disciplinary development as well as the the specific criterion of excellence. At the National Institutes of Health, advisory councils (which consider the relevance of proposals to health goals) were established by legislation even before study groups (which judge purely scientific excellence) appeared. In programs with the goal of building scientific institutions, it is generally acknowledged that expertise and experience beyond the judgment of scientific excellence is needed to make the best funding decisions.

The Committee affirms the importance of the search for excellence as a necessary condition in the distribution of Federal research funds. To fail to obtain expert advice on research quality is to risk misallocation of public funds. However, the Committee also recognizes the importance of wider considerations which enter, often by legislative mandate, into funding decisions.

In its hearings, the Committee gathered information about how merit review is structured in the various research-supporting agencies. Selected descriptions are presented in Appendix I.

Within the National Science Foundation merit review takes several forms.

First, considerations that go beyond scientific excellence are included in the four criteria by which all proposals to NSF are assessed. These four criteria are:

1. Research performance competence. This criterion relates to the capability of the investigator, the technical soundness of the proposed approach, and the institutional resources available to the investigator.

2. Intrinsic merit of the research. This criterion assesses the likelihood that the research will lead to new discoveries or fundamental advances within its field of science or engineering, or have substantial impact on progress in that field or in other scientific and engineering fields.

3. Utility or relevance of the research. This criterion is used to assess the likelihood that the research can contribute to the achievement of a goal that is extrinsic, or in addition to, that of the research field itself, and thereby serve as the basis for new or improved technology or to assist in the solution of social problems.

4. Effects of the research on the infrastructure of science and engineering. This criterion relates to the potential of the proposed research to contribute to better understanding or improvement of the quality, distribution, or effectiveness of the Nation's scientific and engineering research, education and manpower base.

All four of these criteria are taken into consideration in the proposal award decision at all levels -- individual mail review, panel discussion, program manager recommendation, and further management review. The relative weighting of the criteria in the judgments of the reviewers and program managers varies according to the type of project or program.

Second, special steps are sometimes added to the review process to consider particular criteria. In the Engineering Research Centers Program, for instance, first stage peer panels judge the technical excellence of a proposed center and the impact of its educational plan and its plan to involve industry. Then a more broadly based panel is convened to review the best of the proposals for technical and managerial excellence and the importance of their topics to national productivity. Technical excellence and the importance of the topic for technological competitiveness are paramount in the deliberations; geographic distribution and impact on engineering infrastructure are additional criteria. To give another example, when a mathematical research institute was proposed, broad discussion was stimulated within the mathematics community on the best allocation of funds for support of the field. This discussion was taken into consideration explicitly in the final funding recommendation. In the case of Regional Instrumentation Centers in chemistry, a separate step in the NSF review process explicitly considered the question of geographic distribution

Third, particular emphasis on some of these criteria is built into the structure of certain Foundation programs. For instance, in the Visiting Professorships for Women program a panel is convened by a cross-directorate program. This panel discusses mail reviews (which have been solicited by the research program managers) and gives special consideration to the non-research elements in recommending final award decisions. Similarly, funding decisions on projects supported under NSF's International Program are recommended by special program officers, who can weigh the judgments of scientific excellence provided by reviewers against diplomatic considerations.

These varied patterns for incorporating criteria other than excellence into project selections are reflected in other research-supporting agencies as well. Sometimes relevance and excellence criteria are used together, as in most NSF decisions. At the Office of Naval Research, for example, relevance of research to long-term Navy objectives is an important consideration in funding. These judgments are built into ONR's programs in several ways. The distribution of funds among research areas is determined in part through the selection of Accelerated Research Initiatives (ARI's), which are rated on scientific promise and Navy relevance separately, but which are ultimately selected with both criteria in mind. At a later stage, ONR scientific officers select individual projects on the basis of excellence as well as relevance.

Sometimes the two criteria are clearly separated in the review process. At NIH, for instance, study sections organized on a disciplinary basis rate proposals on quality. Then, Institute Councils consider the implications of the proposals for health problems, sometimes departing from the funding priorities the study sections recommend. Similarly, at the Department of Energy, when major research facilities are built, technical review and site selection are treated as distinct steps in the funding procedure. In the case of the National Accelerator Laboratory (Fermilab), for instance, more than 100 proposals were received by the Atomic Energy Commission. The Commission screened the sites to insure that they met basic requirements, including adequate power and water supplies, adequate land areas and enough housing and transportation capacity. Once these determinations had been made, a committee of experts assembled by the National Academy of Sciences further reduced the number of proposals to a short list of sites that met all the requirements for a successful national laboratory. The Commission made the final selection, taking into account all the relevant social, economic and political priorities.

In other facilities programs, however, special panels have used mixed criteria in making specific funding recommendations. One example is the Health Research Facilities Fund, operative at NIH in the 1950's and 1960's. This program used panels which were more diverse than the usual NIH disciplinary study sections. Their members were drawn from several areas of science and included university and hospital administrators. These groups were further advised by a strong staff of architects and engineers. Thus several types of criteria entered into their allocation decisions.

In summary, the Committee found no instance of project selection in which the criterion of scientific excellence was ignored by a funding agency. In single-discipline, single-investigator programs this criterion clearly dominates the decision process. Yet other criteria are frequently incorporated as well through a wide range of mechanisms. Clearly, merit review -- which includes, but is not limited to, considerations of scientific quality -- is a ubiquitous feature of the current Federal research funding system.

VI. FINDINGS AND DISCUSSION

A. Introduction and Overall Assessment

Merit review procedures are constantly evolving in response to the changing requirements of science and engineering and their environments. The Committee is impressed with the inventiveness of the NSF and other agencies in creating procedures to protect the criterion of technical excellence while incorporating additional considerations into their funding decisions.

The Committee finds that the traditional technical peer review process is working well. Although it noted some complaints and dissatisfaction with the system, the Committee believes that a significant portion of these complaints can be traced to financial pressures on the system, which result in declination of many worthy proposals. Other complaints can and should be addressed with improvements: some are suggested below in Section B.

Sections C,D and E discuss the complexities of some of the situations which call for the utilization of criteria beyond scientific excellence in the selection process. These include several special types of programs, such as those which aim to improve aspects of the infrastructure of science and engineering; those which evaluate the potential extrinsic utility of research results; and those which support inter- and multi-disciplinary research. The final two sections (F and G) examine the role of the program manager and the issue of accountability in the review and selection process.

B. Improving Process and Quality of Review

1. The Reviewer Pool

Questions about the openness, characteristics and utilization of the reviewer pool are both sensitive in our democratic society, which tends to be suspicious of elitism and in-group monopolies, and difficult to address because of the lack of data. The several special studies (See Appendix IV) of these issues over the past decade confirmed that there is no evident pattern of discrimination by reviewers in terms of institutional affiliation, age or gender.

How reviewers get into the system, how they are utilized and how long they stay in, are all questions that can only be addressed anecdotally at present. It is also not known how often individual reviewers are asked to work, nor how often they actually submit responses. The Committee recommends a serious effort to develop data to address these questions.

It is known that NSF has a reviewer pool with about 150,000 names; that about one-third of them are asked to provide a review in a given year; that about one quarter of them actually provide at least one review during a given fiscal year; that about 125,000 mail and panel reviews are conducted each year; and that about 15,000 new reviewer names are added each year. These numbers rebut the criticism that peer reviewers are exclusive in-groups. They suggest but do not prove an open system.

Names of new reviewers come from several sources. At NSF each review form contains a space for "additional suggested reviewers." Also program managers ask for suggestions at professional meetings. One suggestion debated without conclusion by the Committee was to ask proposers to nominate possible reviewers for their work. Some NSF programs already make these requests. A number of professional journals routinely request this of their authors, and several instances were recounted where author-suggested reviewers were tougher on the manuscripts than other reviewers. The recruitment of new reviewers at NSF is probably helped by NSF's policy of having a sizeable proportion of its program managers employed as "rotators" for periods of one to three years. Most of these come from and return to university research. Being close to the action they bring fresh perspectives to the programs as well as new sets of reviewers.

Concern was expressed about reviewer response rates. The Committee heard complaints that in some cases 6-7 requests for reviews must be mailed in order to receive three. This level of response could "unbalance" sets of reviewers which had been custom designed for particular projects. However, despite specific probing of agency representatives, the Committee received no evidence of any trend toward reduced response rates. Nevertheless, means to improve or maintain reviewer response rates should be sought. Better feedback to reviewers, if not too costly, would be a valuable courtesy to those who serve as reviewers. For example, all reviewers used by a program in a given year could receive the program's award list at the end of the year.

The willingness of thousands of scientists and engineers to spend hours of concentrated thought on providing reviews without compensation may seem mysterious to many. Reviewing has several compensations, however. There is a certain prestige and recognition to being selected as a reviewer by a major research-supporting agency. Reviewing is also highly educational. It provides a window on forefront ideas in the area of ones specialty. It also educates the reviewer in the format and layout of preparing good (and bad) grant proposals. These are important reasons for broadening participation in the reviewer pool.

Much more information is available about the number and characteristics of scientific advisory panels. (See Appendix V). Their memberships can be, and are, tailored to the functions they perform. They are publicly visible and the fairness and appropriateness of their compositions can be publicly judged.

2. Promptness

The Committee heard evidence of dissatisfaction in this area, especially in the context of exploiting innovative ideas. A nine to twelve month review and award horizon is not conducive to innovative research. The Committee's recommendation under VI-F to provide program managers with some discretionary funds for innovative and creative work would provide "fast track" capability for processing at least some of these ideas. ideas. In addition, several administrative process improvements are under way at NSF which aim to bring the maximum processing time down to six months.

It is especially necessary to seek these efficiencies if greater usage of merit review processes is anticipated. Two stage proposal processing for large projects and projects with wider considerations than the science itself, will tend to increase average proposal processing time.

3. Quality of mail reviews

The Committee heard anecdotes about dissatisfaction with the quality of mail reviews -- perfunctory remarks at one end of the spectrum, and sweeping, sometimes vitriolic critiques, at the other. While it has no reason to believe these extremes are widespread, the Committee recommends that serious study should be made of the extent of these behaviors. The strength of the review process can be no greater than the willingness of the community to participate in it with vigor and integrity.

The issue of whether the names of mail reviewers should be revealed to proposers was raised, but not supported. A complainant suggested that reviewers would be more responsible if their names were attached to the reviews. The counter argument was that signed reviews would fatally dilute the criticism essential to a vital review process. Reviews would become more like letters of recommendation. NSF currently publishes listings of recently utilized mail reviewers at the Divisional level, thus making possible a broad assessment of who is in the pool. However, this does not force a sense of responsibility upon reviewers who may not already have one.

At NSF, as a matter of policy, individual reviews are automatically returned to the proposer; if necessary, they are edited for anonymity by the program manager, but this does not necessarily mean that strong language is excised. It is felt that this practice has an important educational value in improving future proposals. It also provides grounds for complaints to those who feel their work has received inadequate or biased review.

Further, for a number of years NSF has had a formal reconsideration process in place which provides for examination of the technical correctness of the review process. It is regularly, but not frequently invoked. (See Appendix VI).The Committee considered in detail one case submitted by a complainant, and concluded that while several of the specific complaints clearly had substance, the process of review and appeal had worked fairly and well. The reviewer set had included both relatively perfunctory and sweeping, one-sided reviews, but taken as a set, there was a remarkable consistency among their substantive critiques. NSF has sent Special Notices to universities calling their attention to the reconsideration process, but the Committee suggests that NSF explore additional means for advertising the process among proposers.

In sum, given the voluntary and uncompensated nature of the mail review system, the Committee expressed doubts about influencing reviewer performance. Experiments could be conducted inviting proposers to rate reviewers remarks, which could then be transmitted to the reviewers. Letters of instruction to reviewers could be revised to include requests for full coverage and moderate language. Perhaps most important is to provide program managers with the support and the data about reviewers they need to make the best judgments they can in selecting responsible reviewers.

4. Panel versus Ad Hoc Mail Peer Review

Non-scientists, and even scientists and engineers themselves, find the parallel existence of two basic forms of peer project review puzzling.

Ad hoc mail peer review is the predominant form used in the physical and mathematical sciences at NSF. Program managers select a "custom" set of reviewers for each proposal to provide a balanced view of the various aspects of the work. The reviews are advisory to the program manager, who may or may not take the advice. The studies (See Appendix IV) show, however, that there is a very high correlation between average reviewer scores on proposals and the decision to fund. As described above, the names of the reviewers are removed from the verbatim mail reviews and the reviews are automatically sent to the proposer. The program manager in these disciplines writes analyses of the reviews, and relates them to his recommendation to the Division Director. These documents become part of the record, and are likely to be periodically examined in the triennial Program Oversight Review process (See Appendix II). This system is obviously highly dependent upon competent and committed program managers, responsible Division Directors, and alert and active Oversight Review Committees.

Peer panels by themselves, or in combination with mail reviews, are prevalent in the biological and social sciences. NIH uses panels and study sections exclusively. NSF programs in these areas generally supplement panel discussion with mail reviews. The panel process differs from mail review in that it is analogous to a jury proceeding. Panels permit airing of differences of opinion, and if appropriately balanced, can produce more "representative" decisions than mail reviewers operating in isolation. Also, the interaction may produce new ideas, even though this may not necessarily benefit the proposer under discussion. On the other hand, panels may become dominated by one or two powerful personalities, thus tipping the balance in particular directions. Good program managers learn how to handle these cases.

A difference between the NSF and the NIH panel systems is that the proposer in the latter receives only a summary of the panel deliberations on the proposal which may be less informative, if less painful, than verbatim mail reviews. NSF programs in biological and social science return to the proposer both the panel summary, supplemented by explanatory notes from the program managers, and the verbatim mail reviews.

The rhythms and timetables of the panel procedure differ from ad hoc mail review. Proposals destined for a panel process must follow the panel meeting schedule, while the mail process can respond more immediately if funding is available. Also, the costs of the two systems are distributed differently. Panels cost more in up-front agency travel and subsistence funds. The "costs" of mail reviewer time and effort are real and widely distributed, but they are not visibly charged to anyone's particular budgets.

Another important difference is that panels tend to shade into some aspects of merit review. They can be more sensitive to infrastructural issues, and questions of balance and overall direction in a field.

In sum, the Committee recognizes that each basic type of review is rooted in the traditions of different research communities, and that each has certain strengths and vulnerabilities. No strong preference was expressed for either model. Perhaps, like corn, well planned and nurtured hybrid varieties promise the most vigorous yields for the future.

5. Conflict of Interests

In judging one's peers there is no impartial expert. Yet none other than peers are competent to make technical judgments. This is an inherent dilemma in scientific research. There is great reliance on an informal honor system, as well as awareness of the "golden rule" -- what you do to others, may be done unto you. At NSF these strong community norms are codified into a "Conflict of Interest" policy, a statement of which is sent to all reviewers. Reviews with a conflict of interest are not used in the evaluation process. In panel deliberations, panel members with a conflict of interest on a particular proposal must leave the room during the discussion of the proposal in question.

In sum, while concern was expressed that the sense of honor might become frayed during periods of greater competition for tight resources, there are functioning policies in place to minimize bias deriving from conflicts of interests.

C. Merit Review and the Evaluation of the Extrinsic Utility of Research

Section IV A-1 documented the increasing requirements on NSF to link basic research with a variety of national needs, including most recently, the requirements for economic competitiveness.

It must be understood that these developments, at least since 1980, have been taking place in a context in which a fundamental Federal policy of "privatization" has greatly reduced public support for technology development work held to belong in the private sector. In budgetary terms, there have been major reductions in Federal support for civilian applied research and development during this period. In a real sense, a greater responsibility for relevance to applications has been laid upon basic research. Today, a greater burden is placed upon academic basic research support to find ways to improve the contributions of academic training and research to these needs, without compromising the freedom of academic research.

NSF has responded with several special purpose programs, such as Small Business Innovation Research and University-Industry Cooperative Research Projects. New project research programs have been initiated to support work in areas previously not seen as high priority, but now deemed to be valuable to improving economic competitiveness in such areas as design, processing and manufacturing engineering. In addition, NSF has chosen a strategy of creating focussed research centers on campuses to pursue research and training in areas related to national needs. The early version of this approach -- the Industry/ University Cooperative Research Centers program -- relied upon the financial and advisory participation of corporations as evidence of the economic relevance of the proposed work, while obtaining traditional peer review of the scientific and technical promise of the proposed work. In this way, the Federal agency did not set research priorities.

NSF's recent Engineering Research Centers program moves further toward including needs for economic competitiveness in the review process itself. As mentioned in Section IV, these centers have a two stage review process with two partially overlapping panels. The first stage reviews the scientific and technical excellence of the proposed work, the second reviews the subjects covered in relation to future needs. The Committee applauds this mode of overlapping technical (peer) and utility panels (together constituting a merit review process), and generally recommends the approach for large projects and centers intended to have an impact beyond the advancement of knowledge. The selection and meshing of the work of these panels is critical, and requires much attention by program managers.

D. Review of Proposals for Inter- and Multidisciplinary Research (IMR)

Review and funding IMR is a knotty problem for both mail and panel review systems. The majority of NSF's programs are discipline-based, but often the most important and exciting work is going on at the interfaces of disciplines. To deal with multi- or interdisciplinary research proposals there is probably no substitute for specially constituted groupings of reviewers (utilizing both individual mail reviewers and a panel meeting and discussion) whose expertise spans the multiple perspectives and skills required.

The Committee applauds the explicit procedures described by the NSF Engineering Directorate where there is an expectation that a program manager receiving a proposal only partly in his or her field, will seek names of additional reviewers from a program manager in the related area. If the reviews are favorable, joint funding between programs can be arranged. The relatively few "no-home" proposals are sent to a Directorate-wide staff committee primarily set up to receive risky, creative and innovative proposals from program managers. If necessary, this group arranges with a program director for review of the proposal, and if the reviews are favorable, provides half of the funds from its budget, with the other half being from a related program if such a program can be identified.

Where a multi- or interdisciplinary area of investigation appears to be coalescing, a separate program can be set up. At NSF, for example, the Chemistry of Life Processes program represents a cooperative effort between the Directorate for Mathematical and Physical Sciences, and the Directorate for Biological, Behavioral and Social Sciences. In this program proposals are reviewed in a two-step process. The relevant disciplinary programs conduct mail reviews. The results of these are fed into a final discussion by a multi- or interdisciplinary panel.

On the whole in this area, the Committee stressed the role of strong, high-quality program staff. Particularly important is their openness to exploratory inquiries from the field.

E. Merit Review and Improving the Infrastructure of Academic Science and Engineering

1. The need for strong management commitment

Building capacity for science and engineering research requires fundamental legislative and managerial leadership and commitment to framing and fulfilling long range plans and programs. Maintaining momentum is often difficult under pressures from more immediate objectives. Thus, top management must periodically reaffirm the goals, and subject the programs to searching scrutiny for progress toward the goals. This, in turn, requires data bases adequate to the tasks of tracking the developments in given areas of capacity building, and for ascertaining that all the relevant criteria for review and project selection are being utilized.

2. Minorities, women and the handicapped

In discussions of improving participation of disadvantaged groups in science and engineering there is often an implicit assumption of an antithesis between peer review with integrity and a cluster of sensitive equity issues. In some agencies requirements for equity consideration are regarded as a managerial burden, or interpreted as if they are in collision with peer review processes. This Committee believes that the latter is not necessarily the case.

The issue needs consideration, however, because if the system can be made more responsive, there will be less need and pressure for Congress to insert "set-aside" programs into agency budgets. These special purpose programs provide sheltered competitions with access limited to certain classes of individuals or institutions. They do have important transitional value in that they can build an explicit consciousness and sense of responsibility into the organization concerning the needs and characteristics of the communities in question. But these programs tend to be seen as an "entitlement" strategy, which has a negative connotation. Agencies should aim to supersede them with a "preferential" strategy which should reflect a maturing of consciousness within the organization.

A preferential strategy can be seen in terms of building capacity. Planned targets can be devised to increase the capabilities of certain kinds of institutions and/or communities over a given period. This is especially important in a period when there are many more excellent proposals than can be funded. For example, with two proposals of substantially equal quality, the policy could be to fund one from the targeted type of institution, minority group, or gender. (An analogue might be in applications for G.I.loans -- extra points are given for certain characteristics. Of course, the first and fundamental screening must be for scientific excellence, and the extra points for special merit consideration should come afterwards.)

A targeting approach differs in its long-run effects from a built-in, set-aside program for a special group. The latter does not encourage quality in the long run, because it kills important incentives for the designated beneficiaries. Set-asides also encourage another political process which attempts to limit the number of "entitled claimants", which otherwise tend to mushroom.

Another effect of special limited competition programs is that they are essentially "plateau" or "ceiling" strategies. They do not move the institutional or collective capacities beyond the plateau into the terrain of ability to operate in the general competition. The minority research community is somewhat split on this issue. Some are convinced that set-asides are bad, that they virtually label an awardee as someone unable to compete in mainstream science. In fact, some have complained that some NSF Directorates were automatically referring their proposals over to the set-aside pot when they saw the name of the minority institution. Other minority researchers are not as concerned with the mechanism by which they receive their research support.

When moving from special programs to a targeting strategy, problems may arise with accountability. The set-aside is a budget line item which is carefully nurtured and monitored by the target community. It believes it knows that all the earmarked support is being spent in the target community, even though questions about quality may be raised. The targeting approach moves away from this criticism, but it is also much harder to monitor. It requires more target community trust in the intent and goodwill of the agency, and greater agency management commitment to tracking and demonstrating the flow of proposals, review and awards.

In sum, the Committee strongly recommends that agencies make efforts to move toward capacity building and targeting strategies, with strong program management, and serious periodic evaluation of the rate of progress. It must be added that capacity building is a long term process requiring consistent commitment and leadership from top agency managers.

3. Geographical distribution

The Committee examined data presented by NSF on the correlates of geographical distribution of Federal R&D funds and agency awards. On the whole, there appeared to be high correlations between NSF R&D funding to universities and colleges and data on various state characteristics -- for example, per capita state populations, and the number of academic scientists and engineers in each state. (See Appendix III for selected data.)

The Committee applauds NSF's EPSCOR program (Experimental Program to Stimulate Competitive Research) which assists states in which research resources have been limited, to develop their capacities to compete for Federal research funds. EPSCOR is an exemplary case of a capacity building approach, with a well crafted merit review process for project selection. In general, however, the Committee saw nothing alarming in the pattern of distribution of research funds. In fact, seen over recent decades the degree of concentration of funds in academic institutions has even shown a slight decrease.

4. Baccalaureate Institutions

Over the decades Federal R&D policies have paid little direct attention to the non-doctoral sector of academia. Federal science and engineering manpower development programs have focussed primarily at the graduate levels. In recent years federal policy makers have been concerned with improvement of precollege science and mathematics education.

The role of baccalaureate institutions in identifying and nurturing science and engineering talent is critical because these schools graduate over one third of all baccalaureate degree recipients who go on to earn science and engineering doctoral degrees. Also, these schools provide a significant proportion of the bachelors and masters degree graduates in science and engineering who enter directly into the labor force.

The NSF programs to support research projects and research equipment awards in these institutions are good examples of a capacity building and targeting strategy. Program manager initiative is especially important to stimulate proposals from the institutions, and to provide liaison with the research programs which conduct the technical review process.

5. Selection Process for Academic Science and Engineering Research Facilities

One reason for the formation of this Committee was concern with the absence of technical review of academic science and engineering facilities projects introduced into Federal Agency appropriations bills by means of Congressional "floor amendments."

The members of the Committee are unanimous in their conviction that well thought out programs for Federal contributions to building and refurbishing academic research facilities are indispensable for the vitality of the Nation's science and engineering enterprise. Further, the Committee believes that given the widely noted need for renewal of academic research facilities, the absence of any regularly budgeted Federal agency programs for facilities support is driving institutions to seek such funds wherever they can find them, including directly from their Congressional representatives.

No one questions the right of the U.S. Congress to entertain petitions and to provide support for such projects as it sees fit. Large projects for research facilities may often have important implications beyond their scientific or engineering merit -- such as impact upon local or regional economies and employment. Nevertheless, the funding of science facilities without systematic technical review can be likened to building a dam without the assurance that there will be water behind it. Obviously, facilities support and project support are closely linked -- empty or underutilized facilities waste resources, as do projects conducted in inadequate facilities. Planning is essential.

A good illustration, which could be applied to other fields, is the nation's oceanographic research fleet. A balance of ships with different capabilities, based in east, gulf and west coast ports must be arrived at, phased into supporting agency budgets to allow for replacement and repairs, and carefully integrated with a longer range research plan. The planning process must include all the interested technical parties. Adding ships to the fleet outside the plan can cause dislocation and waste of resources. Such difficulties are likely to be compounded if no independent technical review is conducted. These matters are of special concern during a period when the priority needs of science and engineering cannot be fully supported because of budgetary stringencies.

Congress is, of course, aware of these issues, and it has taken a number of recent initiatives to identify needs and to explore policies and programs in the area of academic research facilities. Bills have been introduced and debated, hearings have been held, and the creation of a sound data base has been ordered. The Committee recommends that NSF urge that the process of determining Federal responsibilities in this area be rapidly completed.

Until regularly budgeted agency programs for facilities support are in place, however, the Committee believes that the Congress should explore setting up a process for obtaining independent technical assessment of proposed academic facilities projects prior to including the items in agency budgets. For example, it could set up an Academic Science and Engineering Facilities Authorization process which would funnel all the requests through a single path. A special group could be set up in the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) to coordinate reviews, which could primarily be conducted by the executive branch agency envisaged as providing the budget.

Under such an arrangement the Congress, of course, remains free to set its own priorities, but it would at least have the benefit of an independent finding about the scientific or engineering potential of the project. An analogue is the voluntary process whereby the President requests and is provided with a technical assessment of the qualifications of proposed candidates for the Federal judiciary. No one is bound by the findings, but they make for better informed decisions.

F. Program Manager Discretion

The qualifications and commitment of the program managers form a critical element in any system of project review. The program director is responsible for generating and properly using the flow of advice and opinion on his program projects, as well as addressing new opportunities in his or her area.

The program manager must find a proper balance between running the review machinery and keeping it accountable, and acting as a stimulant and catalyst for new opportunities by encouraging proposals from the best in the research community. The greater the overlay of inflexible procedures and requirements, the less attention can be devoted to issues of substance. Too much bureaucracy also reduces the likelihood of attracting and retaining high quality, creative personnel.

The need for program manager discretion and innovation becomes more important if, as is widely believed despite the absence of confirmatory studies, the peer review process tends to have a centrist bias -- especially in times of tight resources. Peer review is believed to function as a "modulation" system which effectively cuts out the low end of the proposal quality distribution, but may also chop off part of the top end of the curve -- work seen as obviously creative, but non-traditional or highly risky. A competent program manager would want to have a (small) portion of the program funds invested in high-potential but high-risk work.

In the light of these considerations, the Committee was favorably impressed with a new experimental procedure in the NSF Engineering Directorate which permits program managers, on their own initiative, to expend up to 5% of their program budgets on certain kinds of innovative small projects. These proposals are subject to internal review but are not required to undergo external peer review.

A similar practice, but for renewal proposals, was initiated several years ago by the NSF Chemistry Division, and has since been extended to all of NSF. In this procedure (Creativity Awards) program managers can commit up to 10% of their program budgets to renew or extend exceptionally promising pieces of work without new external peer review. Both of these practices reward and encourage creativity. They also significantly cut down on paper work and provide a "fast track" mechanism to take advantage of opportunities.

The program manager also plays an important role in project selection in some NSF programs which use a preliminary proposal process, e.g., Informal Science Education, and the Program for the Analysis of Science and Technology Resources. In these programs brief informal preliminary proposals are required or encouraged. They are reviewed by staff for promise and relevance to program goals, and on the basis of this review, preparation of a formal proposal is either encouraged or discouraged. A formal proposal may be submitted irrespective of the staff recommendation, although in most cases the staff recommendation is followed. The staff recommendation on the pre-proposal has no bearing on the technical review process once a formal proposal is submitted.

The burden of accountability for activities initiated by program managers rests upon post-performance evaluation by superiors and outside program review groups. In general, as one reduces the burden of prior technical review (on the grounds that the program manager is a responsible technical judge) one must increase post-performance evaluation activities.

NSF policy requires that each research program be subjected to a thorough external review of substance and process once every three years. This Program Oversight Review process is conducted by outside panels, frequently sub-groups of Divisional Advisory Committees. The oversight groups look at samples of grant documentation for both awards and declinations, and they assess the fairness and scientific balance of the program manager's judgments. The groups' reports are made available to upper management and the NSF Director, who, in turn, makes an annual report on the oversight review process to the National Science Board (See Appendix II).

While acknowledging the importance of letting creative and non-traditional ideas in "at the front door," it is also recognized that the research system is full of "back doors." The very nature of scientific research is uncertainty. Thus, the connection between the content of proposals for research and the working out of the research process cannot and should not necessarily be direct. Abuse of the obvious need for flexibility, i.e., non-performance, as opposed to good-faith pursuit of alternative lines of work, can be partially controlled by alert and knowledgeable program managers. In addition, NSF has recently instituted a requirement in its review process that asks investigators to include descriptions of prior NSF supported work in their proposals. Reviewers are requested to record their judgments about past performance.

The role of the program manager is especially critical in special-purpose programs, such as small business innovative research, special programs for minorities and women, for small colleges, and for research capacity building in "have-not" states. Special knowledge of, and intensive interaction with, the target communities require much program manager time and initiative.

G. Accountability in the Review Process

A hallmark of scientific research is its insistence upon open publication of work which is freely accessible by the whole community. This rigorous accountability is enforced by community vigilance on questions of priority in discovery. This openness is apparently contradicted by the anonymity of merit review processes, whether in competition for awards or research support, or for publication of work in scientific journals. It is a doubly difficult matter to comprehend when public funds are involved. Merit review as practiced in Federal agencies remains advisory to the agencies, thus keeping the public officials responsible for decisions. But probably in no area of public endeavour other than science are public officials permitted to keep the identities of at least some of their advisors confidential.

This situation makes the system peculiarly vulnerable to the criticism that in-groups may exercise undue influence upon decision-making. Critics propose as remedies a variety of set procedures, documentation, and requirements for disclosure and auditability, in sum, more bureaucracy. Yet a major theme that pervaded the presentations and discussions before this Committee, was the need for informality and flexibility, and the capacity to make subtle distinctions which themselves may be disputable, but which nevertheless stand on the reputations, credibility and professional integrity of program officials and reviewers alike. These are the qualities needed to support and propel the discovery process in basic science.

On the grounds that increased accountability can be obtained by providing information about how a system works, the Committee strongly supports the creation and maintenance of a significantly improved data base about the review process. (See the recommendation in Section VI B1). Improved data should benefit both the research managers themselves as well as wider public understanding of the advice system.

APPENDIX I

PEER REVIEW IN SELECTED FEDERAL AGENCIES

Excerpts from Testimony Before the U.S. House of Representatives, Committee on Science and Technology, Science Policy Task Force, Hearings on "Research Project Selection"
April 8-10, 1986

1. National Institutes of Health
Excerpts from testimony of Dr. Ruth L. Kirschstein
Director, National Institute of General Medical Sciences

Peer review procedures for health research supported by the Federal Government were initiated in 1902. At that time, the Fifty-seventh Congress established a Scientific Advisory Board of non-governmental scientists to assist the Surgeon General in the administration of the Hygienic Laboratory. In later years that Laboratory was renamed the "National Institutes of Health." And the Advisory Committee was reconstituted and renamed the "National Advisory Health Council."

When the National Cancer Institute was established in 1937, the Cancer Act also provided the legal basis for the National Advisory Cancer Council. The Act stated that the Council was to play a key role in recommending the award of grants. These authorities and procedures were extended to grants and fellowships in health research areas of all the NIH Institutes in 1944, when the Public Health Service Act was passed.

In 1946 the director of the NIH recognized the need to establish a more formal advisory mechanism for the assessment of technical and scientific merit by using a system of initial review groups, also called "study sections." Study section review is the first level of the NIH peer review system. Each study section is composed of 14-20 non-governmental scientists having national stature in a particular discipline--for example, biochemistry, hematology surgery, genetics, molecular biology. These initial reviewers constitute the true scientific peers of the persons submitting research grant applications.

The review groups usually meet three times a year, for 2-3 days per meeting. At the meeting, each research grant application is presented and discussed individually, in detail, by particular assigned reviewers, after which there is general discussion leading eventually to the development of a consensus. Each application is assessed for such factors as: the objectives of the research; the research protocol; the capabilities of the investigator and his or her associates; the research environment; the probability of success; the appropriateness of the budget to the tasks described; and the scientific significance of the proposed research.

The study section has three options, arrived at by majority vote: approval, if the application is deemed to have scientific merit; disapproval if it is considerd to be devoid of such merit; or deferral. If insufficient information is presented for formulation of a fair and rational recommendation, the study section may recommend deferral in order to obtain the needed information or to resolve any problems. If a recommendation is made for approval, then each Study Section member assigns privately a numerical priority rating based on his/her individual evaluation of the particular application. The possible scores range from 1 to 5, with 1 representing the most favorable assessment and 5 the least favorable. The assigned scores are then averaged and computed into a final overall "priority score" representing the entire group's opinions.

The initial reviews performed on each research grant application are translated into a written "summary statement." This includes a critique, a recommendation, and, if favorably recommended, a priority score.

This is the first level of the Review System. However, it must be stressed that the NIH peer review system is a dual one. The second level occurs subsequent to the first and is carried out by the legislatively mandated National Advisory Council, of which there is one for each Institute. Each Advisory Council has the broad function of advising on the overall programs of the Institute as well as the legal responsibility for recommending those research projects for which funds are to be awarded.

A National Advisory Council consists of 12 or more members, some of whom are senior scientists and others, community leaders in areas relevant to the responsibilities of the particular Institute. An Institute may award a research grant only if it is recommended for approval by its Advisory Council. If the Council does not recommend approval, an Institute may not award the research grant. It is the Council's responsibility to review t appropriateness of the assessment by the study section and to make final recommendations regarding program relevance, significance, and the priority of the research in relation to t Institute's mission.

By means of this dual system, there is a mandatory separation of the assessment of projects purely regarding merit from the subsequent policy recommendations as to the scientific areas of importance in which projects will be awarded and the level of resources to be allocated to those areas.

2. National Science Foundation
   Excerpts from testimony of Dr. Mary Clutter
   Senior Science Advisor

Except for a few notable large-scale initiatives such as the engineeering research centers and supercomputer centers, most proposals received by the Foundation are not in response to specific solicitations or formal requests-for-proposals of the type that many other agencies employ. We do, of course, publicize our programs extensively, specify the format for proposals, and encourage direct contacts with our program staff. But the bulk of the proposals are unsolicited; that is, the research ideas and methods are those of the applicants.

The mechanics of proposal handling can be described simply. The research programs of the Foundation are organized along the lines of fields of science and engineering. In the FY 1987 budget you will find some 140 research support programs in 27 Divisions. The proposals come into a central unit, where a file is established and they are assigned to the appropriate Division for handling. They are then further assigned to a program officer. It is important to note that these program assignments are made by scientists and engineers who know the subject matter.

Before I tell you about their important role, let me describe a typical program officer. Counting Division and Section Chiefs, there are about 300, or more than a quarter of the total Foundation staff. All of them have significant research experience, and almost all have doctorates. They are recruited for the breadth and depth of their specialized knowledge as well as for the personal qualities they will need to deal with the prominent scientists in their field and the many other demands of the position.

At any one time, about a third are one- and two-year "rotators" on leave from their universities and colleges. The Foundation places a very high value on recruiting and using "rotators" because they have recent bench-level experience and are able to infuse our decision-making systems with their fresh viewpoints. Many of the permanent staff began as "rotators".

Over the course of several months, the program officer oversees the external review, evaluates the comments of the reviewers, and makes a recommendation as to whether the proposal should be awarded or declined, taking into account other considerations-- such as the relationship of a particular proposal to the field as a whole and to other pending proposals, and the amount available in the program's budget.

The program officer's recommendations are reviewed at one or more higher levels. Approval recommendations are then forwarded to specialists in the Division of Grants and Contracts, who check on all the nonscientific aspects of the award and issue the formal notification to the applicant's institution. In some cases, as with a sizable request for funds or, for example, the first group of proposals in a new program, the recommendations are further reviewed by an Assistant Director and by the National Science Board.

Ensuring the quality, completeness and fairness of the external review is one of the principal responsibilities of the program officer. The review process employed depends on the tradition of the particular field of research; in the physical sciences and engineering, proposals are usually mailed to reviewers who respond individually; in the biological, behavioral and social sciences, a panel of scientists reviews the proposal in addition to the mail review, for large projects and special competitions of various types, reviews are often supplemented with site visits by NSF staff and teams of outside experts.

In the mail-out procedure, the program director sends each proposal to several people--sometimes as many as ten--whom he or she has identified as knowledgeable on the topic. The reviewer receives standard instructions and review forms, and responds directly to the program officer. Where panels are used, groups of experts meet at some specified interval--generally three times a year in the larger programs--to weigh a group of proposals, taking into account the comments of the ad hoc reviewers. The first criterion in choosing panelists is expertise in the field: then we look to balance the panels with regard to such factors as institutional size and participation of women and minorities. Panelists serve for a specified period of time; commonly, some portion of the panel will rotate off each year.

Both methods of peer review have pros and cons, and both have advocates who strongly defend them and would be very reluctant to change. The type of review used in a program has grown out of the scientific tradition in that particular field; most applicants in a given field are familiar with it and understand it. On average, no matter which method is used, a proposal has the benefit of 5.5 completed external reviews.

To give you some idea of the scale of operations, during FY 1985, the Foundation took final actions on 24,403 competitively reviewed proposals. Of these, 7,968 were awarded; almost twice as many, 15,504, were declined; and 931 were withdrawn by applicants prior to a decision. Obviously then, overall, about one-third of the total completed actions became awards. Some programs historically have higher ratios of awards to declines, some lower, depending on a lot of factors including the size of the program budget and the nature of a typical award in that field.

In Fiscal 1985 a total of 59,725 individual reviewers and panelists contributed their services to NSF. They came from a wide range of institutions--not only academic institutions, large and small, but from industry, Government and even foreign research and educational organizations.

As that total shows, program officers are always on the lookout for qualified, knowledgeable reviewers from all backgrounds. There are very practical reasons for that: fresh insights and advice can be a valuable contribution to decisions, particularly when one is trying to discern the best proposal among many of substantially equal merit; and certainly one does not want to overload individual reviewers (however knowledgeable) with too many requests.

The specific factors that we ask reviewers to take into consideration are spelled out for applicants in our publication entitled "Grants for Scientific and Engineering Research." Basically, the National Science Board has set forth four criteria to be applied to all proposals "in a balanced and judicious manner." They are:

(1) Research performance competence: That is, the technical soundness, the capability of the investigator(s), and the adequacy of institutional resources available for the work;

(2) The intrinsic merit of the research: that is, the extent to which the proposed work is expected to lead to new discoveries or fundamental advances in its field or across fields of research;

(3) Utility or relevance: the extent to which the work could contribute to an extrinsic goal such as a new technology; and

(4) The effect on the infrastructure of science and engineering; that is, what the work will contribute to the Nation's research, education and human resource base.

The relative weights of criteria (2) and (3), intrinsic merit and utility, depend on the character of the work. The fourth criterion allows the program to take into account such questions as the participation of women and minorities, institutional distribution, and the stimulation of important but underdeveloped fields of research. In many cases programs also use special criteria related to their purpose as in, for example, specialized programs for equipment grants or visiting professorships for women. In any event, the scientific merit of the proposed work and the competence of the applicant are the principal factors.

Reviewers are asked to provide not just an overall rating but narrative comments, including comments on the researcher's earlier completed work where pertinent. These narratives are more valuable than the ratings themselves, not just to program officers in arriving at their recommendations but to applicants, who routinely receive them, as I will explain in a moment. The program officer's job is only half finished once the reviews have been completed. It is easy to make recommendations to fund very highly rated proposals and to decline very low rated ones. But there is always a middle group, sometimes a sizable one, of meritorious proposals all of which would be worth funding if enough money were available. Because that's rarely the case, we call on the program officer to use his or her scientific judgement, experience and discretion in selecting among them.

The Foundation has a tradition of selecting program officers not only for their research experience and other technical qualifications but for their integrity and objectivity. And as I indicated, their recommendations are examined in turn by more experienced Section and Division Directors familiar with the broader scientific and policy environment within which the Foundation operates.

To ensure an open and fair system, we have built in several other safeguards, both for the individual applicant and to satisfy ourselves that the system as a whole is operating as it should.

First, Foundation policies and practices about potential conflicts of interest, or even the appearance of conflicts, is very clear and made known to reviewers and program officers. We ask them to identify any academic affiliations, personal relationships or financial interests that could constitute or be regarded as a conflict, and to withdraw from the decision process if warranted.

Second, since the mid-1970's we have routinely sent all of the reviews to the applicant verbatim but without attribution to individual reviewers. This system provides for the interests of both applicants and reviewers--reviewers because some of them might be reluctant to be entirely candid otherwise; and applicants because they find the reviewers' detailed comments very valuable for explaining a decision and for reformulating their proposal if they wish to resubmit it.

Third, we have a system for formal reconsideration of proposal decisions, at the request of the applicant. This is not a "de novo" review of the scientific merits but an examination of how the case was handled by the program officer. Reconsiderations are carried out by persons not involved in the earlier decision. An applicant not satisfied with the initial reconsideration may have his or her institution request a further reconsideration by the Foundation's Deputy Director.

We also take measures to examine our process systematically: First, staff of the Director's office of Audit and Oversight routinely examine a small random sample of actions for compliance with Foundation procedures and provide direct feedback to the program division.

Second, every one of the programs is given a comprehensive review every three years by a small group of external peers familiar with the field. These "visiting committees," if you will, make formal reports to the NSF Director about each program. The reports, and the annual summary, are publically available.

These peer oversight committees select their own sample of actions and address such matters as whether the selection of reviewers, the program officer's rationale for recommending an award or declination, and the balance among projects selected are reasonable. ... The comments of these external peers about the professional stewardship of the NSF staff are generally very favorable.

Third, we have undertaken some experimental studies of the proposal review and award system as a whole. Our Program Evaluation Staff, which is part of the Controller's office and thus independent of the Program Divisions, has run various statistical tests on carefully-constructed samples to see if the system has been "fair" to certain classes of applicants. Here are some of the findings:

> (1) For NSF as a whole, about one of every four new proposals are funded, and about one of two renewal proposals. Generally, renewal proposals receive better ratings, but even where the ratings are about the same, the renewal is somewhat more likely to be funded.
>
> (2) Proposals of roughly the same quality as indicated by the ratings have the same chance of being awarded or declined no matter what states the proposals are from.
>
> (3) Beyond the ratings, and whether the proposal is new or a renewal, none of the following three factors have a statistically significant effect on decisions: The prestige of the applicant's department, his or her "professional age," or the amount of money requested.
>
> (4) There are other less global but nevertheless interesting results. For example, there is no statistically significant difference in the ratings that male reviewers give to proposals from women compared to men.

3. Department of Energy
Excerpts from testimony of Dr. James S. Kane,
University of California
(Former Deputy Director, Office of Energy
Research, DOE)

Energy Research is a very large funder of research, even by federal standards. Its annual research budget exceeds $1.8 billion, most of it basic research, the remainder being highly sophisticated applied science. Energy Research is also the principal organization of the federal government in the construction and operation of very large facilities used for basic research--accelerators, including the ones at Fermilab and at the Stanford Linear Accelerator Center, nuclear research reactors, synchrotron light sources and other large and expensive scientific facilities. So peer review, in Energy Research, is used not only to choose the scientists that are to be funded, it is used in addition to choose the experiments to be done on these expensive facilities, whose operating costs can be thousands of dollars an hour. ... The large research facilities are used predominantly by university scientists. In the case of the high energy particle accelerators, for example, the university community comprises about 75% of the users.

Before I start describing how Energy Research uses peer review, let me first define what I mean by this term. I can identify at least five different kinds of peer review, all of them used to varying degrees by Energy Research:

1) Mail reviews of written proposals, done individually by several (usually 5 or 6) experts. The proposer does not know the identity of the reviewers. These reviews are prospective, in that they evaluate promise, not performance, although the past record of the proposer is invariably considered.

2) Panel reviews, based on written proposals evaluated by a panel of several experts, which collectively rank-orders the proposals. These reviews too, are prospective.

3) Oral panel reviews, in which a panel of experts evaluates a proposal, usually on the basis of both written and oral presentations. These too, are prospective.

4) Progress evaluations of individual research projects, usually by an appointed panel of experts, with a presentation by the project scientist. These reviews are retrospective. Progress, rather than promise, is evaluated.

5) Evaluation of group efforts, by a panel of experts. Again, the review is retrospective. The evaluation is focused on accomplishments and progress.

As I stated above, Energy Research uses all of these forms of peer review. The first three are the most common for research sponsored at universities, and the latter two for research at the National Laboratories, but there are occasions where process 1) is applied to work at the Laboratories, and process 5) is applied to work at universities. I think nearly every basic research project sponsored by the DOE is subjected to one or more of these processes.

I mentioned earlier that the allocation of time on the expensive research facilities at the DOE laboratories is also done by the peer review process. Each research facility has a program committee of expert scientists. A majority of the committee is from institutions other than the one at which the facility is located. This committee reviews all proposals that involve use of the facility, and rank-orders them by merit. This procedure ensures that scientists from the site where the facility is located do not have an unfair advantage in gaining access to the facility. Most of the scientists doing experiments at a facility are from other institutions.

4. Office of Naval Research

Excerpts from the testimony of Dr. Marvin Moss,
Director, Office of Naval Research

Any discussion of ONR's project selection process must recognize the fact that ONR is a mission oriented sponsor of basic research. It encourages the acquisition of fundamental knowledge needed to solve future military problems in areas such as communications, surveillance, targeting, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support. The Navy of the 21st Century is being planned now through the research supported by ONR.

Because of ONR's mission orientation, project selection must be a two step process. First, it must establish broad programmatic thrusts and priorities reflecting a suitable balance between Navy need and relevant scientific opportunity. Next it must select specific research projects and tasks to implement those broad thrusts and priorities. ...

Partially because of its unique mission, ONR depends primarily on its Scientific Officers for the selection of specific research projects. Academic peer reviewers cannot be expected to be knowledgeable about the Naval mission and its research implications. It is ONR's exceptional cadre of Scientific Officers who made its past record of achievement possible. ONR Scientific Officers are encouraged, as a matter of policy, to be active researchers and to play a leadership role in the scientific community while, at the same time, establishing and maintaining close communication with the Navy technology development and operations communities who will ultimately use the products of their research programs. ...

The ONR program employs a variety of mechanisms to support research at universities. In some cases, special objectives are included in the selection process. For example, we recently established a program to identify and support exceptionally promising young investigators. Other special programs are designed to foster substantive cooperation and interaction between research personnel at Naval laboratories and their counterparts at universities. However, the vast majority of our program is implemented through the mechanism of project contracts with individual principal investigators for research projects that are selected on the basis of scientific quality considered in the context of Navy need.

The ONR Scientific Officers play the key role in project selection and management. They are given broad discretion in the selection of external projects for support, and are then held responsible for their results. Although there is no formal peer review process at ONR, the Scientific Officers do seek the advice of associates within the Navy and of appropriate experts external to the Navy. The methods employed to seek expert advice, which may be highly structured or informal, are determined by the Scientific Officer to meet the particular needs of his or her program. External reviews, if employed, are advisory. The Scientific Officers are ultimately responsible for a project's contribution to Navy goals. The decisions of the Scientific Officers are reviewed by Division Directors and by appropriate science management. However, those decisions are rarely reversed. The ONR Scientific Officers are heavily involved in project monitoring, including site visits, and it is they who must answer for their programs in periodic program review and evaluation by upper management.

The ONR program that has resulted from the processes that I have just outlined has the following characteristics:

-60 to 65% long-term research to advance the state of knowledge across the spectrum of disciplines relevant to the long-term Navy needs.

-15% focused on long-term high-risk efforts with high potential payoff.

-20-25% devoted to programs closely associated with specific applications with defined transition potential.

Because of the requirement to select programs that have outstanding scientific merit and fit into an overall set of programmatic priorities, the ONR Scientific Officers cannot be passive and simply react to proposals as received from the academic community. They must play a very active role in communicating ONR's programmatic interests and priorities to the academic community and in seeking out scientific opportunities relevant to Navy priorities. Not only do they spend considerable time visiting university laboratories and scientists for this purpose, they also organize special conferences and workshops and monitor and participate in relevant activities of the National Academy of Sciences, professional societies and other organizations. To do this effectively, they must have established a certain level of visibility and stature in their research communities.

On the opposite side of the coin, the Scientific Officers very actively seek out mechanisms to ensure current knowledge of Navy and DOD needs. To cite just a few examples, many of our Scientific Officers take on responsibilities beyond their principal role as Navy research managers to also manage Navy development programs, and programs of DARPA and SDIO. In addition, they consult on special near term problems faced by Naval fleet and operations personnel.

Before completing my remarks on the topic of project selection, I would like to describe somewhat more structured approaches currently employed for two special purpose programs that represent a relatively small but important fraction of our total program. I am referring to the ONR Young Investigators Program and the ONR URI Block Research Program. Both programs are components of DOD's University Research Initiative established in FY-86 to strengthen the ability of U.S. universities to perform basic research and to train scientists and engineers in areas vitally important to the national defense.

The ONR Young Investigator Program is intended to attract the best and brightest young academic researchers to areas of research that are important to future Navy requirements by providing special recognition and stable funding for research at a level consistent with the purchase of equipment and support of graduate students. The goal of the program is to provide a future resource of informed, committed scientists and engineers, and to establish strong long-term ties between DOD and outstanding academics. It must be clear that the proposed investigator is a potential leading faculty member with a strong commitment from the university's officials. Base funding for each young investigator is $50,000 per year for three years. As an incentive for becoming involved with such Navy research activities as the Navy laboratories and the Navy Systems Commands, ONR will match on a 2-for-1 basis support gained from these sources. ONR matching funds are limited to $80,000, but this does not prohibit a young investigator from getting more than $40,000 from other Navy sources.

It is often claimed that young investigators sometimes are placed at a disadvantage by "peer" and other conventional project selection processes. We wish to insure that particularly promising bright candidates receive appropriate recognition and encouragement. The program is announced via a specific program announcement. One hundred and seventy-nine proposals were received in response to our FY-85 announcement. Unfortunately, we were only able to fund ten.

All Young Investigator proposals are initially screened by the directors of the ONR divisions responsible for the research area identified by the candidate young investigator. Division directors in turn present the case for their most promising candidates to a selection panel composed of ONR's Research Advisory Board and myself. Young Investigator proposals are scored on the basis of creativity of the proposal, past performance of the candidate, and evidence of excellence and commitment on the part of the candidate's university. Consideration is also given to a desire to have a reasonable balance of young investigators across Navy relevant areas of science and engineering.

Block Research Programs. As already noted, ONR has traditionally emphasized the individual project contract. Broader institutional support mechanisms have been employed, particularly in the ocean sciences, but even in those cases institutional proposals are evaluated essentially on a project-by-project basis. In FY 1986, under our newly established University Research Initiative, we will begin to support a number of new block research programs at U.S. universities.

The Navy URI research programs are designed to increase the number of science and engineerng graduate students; to increase investment in major pieces of research equipment at universities; to increase the investment in higher risk basic scientific research in support of critical Navy and DOD technologies; and to provide more opportunities for contacts between universities, industry, and Navy and other DOD laboratories to maximize the benefits to be derived from defense research for the nation's security, both military and economic. We recently issued a broad area announcement, jointly with DARPA, that requests proposals in 20 broad areas of science and technology critical to the DOD mission ranging from mathematics to arctic science and engineering.

The ONR block research program contracts will have a maximum life of five years with maximum annual funding of four million dollars per year. The block research program selection process can be summarized as follows:

- A proposal evaluation panel will be established for each of the research areas identified in the ONR/DARPA broad agency announcement.

- Each proposal evaluation panel will be chaired by an appropriate ONR Scientific Officer and/or DARPA Program Manager who will ultimately be responsible for recommendations and management of the block research program(s) awarded in the subject research area. Other members of the evaluation panels will include appropriate representatives from in-house Naval laboratories, the Army, Air Force, DARPA, NSF and industrial research organizations. Academics may be included when it is clear that conflicts of interest are not present. Where appropriate, other interested government agencies may be represented (e.g. NOAA or NASA in ocean remote sensing).

- Evaluation panels will review and discuss all proposals received in their subject areas and rank them into three categories. Site visits (typically 1 1/2 days in duration) will be made for all proposals in the highest category. Upon completion of site visits, each of the proposal evaluation panels will make recommendations to a Program Selection Board consisting of ONR's Research Advisory Board supplemented by representatives from DARPA, Army, Air Force, DUSR&AT and appropriate Directors of Navy Laboratories/R&D Centers and the Director, ONR.

- Final selection will be made by the Program Selection Board.

- o All selections will be reviewed by an appropriate DOD committee prior to announcement to ensure coordination of Army, Air Force, DARPA, and Navy block research programs.

In order to satisfy the research objectives of DOD and the Navy, ONR uses a number of mechanisms to sponsor research. Historically, greatest emphasis has been placed on the individual project contract which we still believe represents the best mechanism for supporting work of the highest scientific quality within the context of naval requirements. Partially because of its unique mission, ONR has placed less emphasis on formal peer review in its selection process than some other research sponsors. However, the key to the ONR project selection process has always been the ONR Scientific Officer, who is a state-of-the-art scientist or engineer, not a contract administrator. The ONR Scientific Officer must be an activist with a broad knowledge of his or her discipline and an understanding of its relevance to the naval mission. ONR's record of accomplishment is more the direct result of the outstanding quality of its Scientific Officers, and the authority given to them, than the result of any particular process for project review and selection.

5. Department of Agriculture
Excerpts from testimony of Dr. Neville Clarke,
Director, Agricultural Experiment Station,
Texas A&M University System

State Agricultural Experiment Stations receive sizable appropriations from the state legislatures, generally in accordance with the size and relative importance of agriculture in the individual states. In addition, federal appropriations are awarded by the USDA in three ways: 1) formula-based funding; 2) special grants; and 3) competitive grants. Other federal funds from non-USDA sources may come from any of the federal granting agencies. In addition, the State Agricultural Experiment Stations receive varying amounts of industrial funds as well as private endowments. To a minor degree, they receive some support from selling the excess agricultural products associated with their research.

Funding of agricultural research by the USDA relies on a system of peer review for all three kinds of research grants as well as explicit methods for accountability and evaluation of research productivity. These will be discussed in more detail in succeeding parts of this testimony.

Formula Based Funding. The legal basis for formula funding resides in three key pieces of legislation: the Hatch Act which was passed in 1887; the Evans-Allen program which was first funded in 1967; and the McIntire-Stennis legislation which was passed in 1962. Hatch funds are for a broad scope of agricultural research; Evans-Allen funds support agricultural research in the historically all black institutions; and

McIntire-Stennis funds support forestry and forest science research.

Appropriated by Congress, formula-based funds are distributed to the individual states by the Cooperative State Research Service on the basis of a "formula" that, generally speaking, has to do with the number of farms or enterprises, rural population and the size of the agricultural or forest activity in the state. One-fourth of the funds appropriated under the Hatch Act must be spent on cooperative regional research projects.

Though the funds are distributed to the individual states on a formula basis, it is important to recognize that individual projects are subjected to peer review within the individual states. The proposals that are approved at the state level must then be approved by the Cooperative State Research Service before formula funds can be spent on the projects. In the case of regional research projects, a national committee, called the Committee of Nine, reviews and approves regional projects as well as interregional projects that utilize Hatch Act funds.

Individual research projects are evaluated by annual progress reports submitted by the scientists and by periodic reviews. In addition, the Cooperative State Research Service helps the individual State Agricultural Experiment Stations organize and conduct in-depth reviews of a total program or subject matter area approximately once every five years.

Perhaps one of the most important aspects of formula-based funding is the intentional commingling of state and federal funds to support agricultural research. This is a fiscal manifestation of the unique state-federal partnership that has provided the new knowledge necessary to make U.S. agriculture the most productive in the world. This partnership allows a very substantial leveraging of federal funds that are provided for research within the states. The criteria are well established for approving the use of federal formula funds for research that applies to a multi-state objective or to a national problem. ...

The individual research programs that are partially sponsored by formula-based federal funding are also dynamic in terms of the turnover of research projects, which occurs every three to five years. Although some funding stability is necessary for long-term agricultural research such as the development of new plant and animal germplasm, there is, within the formula-based funding activity, a substantial flexibility of resources, allowing adjustments with redirection of efforts toward critical issues. When these areas of research are viewed in the aggregate from a national perspective, it is sometimes difficult to portray the mobility that actually exists in individual states or in individual projects.

One of the major characteristics of formula-based funding is the utility of these funds in early problem-solving and in developing awareness of emerging agricultural problems and opportunities that need to be addressed by research. There are numerous examples of the timely initiation of new research with formula-based funds; research which has provided the infrastructure and, in some cases, the pilot studies that have identified the need for new initiatives subsequently funded by either special or competitive grants. Changes in the base program of research funded by formula-based resources come not only from internally initiated perceptions of need, but may also be externally driven by interactions with the commodity groups, the Congress and the Administration. There are a number of examples that could be cited to illustrate the dynamics of the base program. ...

Special Grants.. The USDA's Cooperative State Research Service has awarded special grants over the years for research in areas of need or opportunity targeted by the Congress. Over the years, many of these special grants were highly specific to research needs and problems in individual states. Increasingly, the special grants are funding projects more regional and national in scope and application. Special grants are also now awarded on the basis of a peer review process that ensures the scientific merit of proposals submitted for funding. Special grants, however, are a relatively small part of the total USDA budget for cooperative research with the states. In FY86, $28.6 million was provided to USDA by the Congress for special grants.

Competitive Grants. The 1977 Farm Bill initiated the USDA's competitive grants program and the funding for it has continued to increase in the intervening years. The USDA modeled its program after the National Science Foundation's approach to grant evaluation and award. The State Agricultural Experiment Stations enthusiastically supported this program once initial concern was allayed that funding for the competitive grants program might be transferred from formula-based funding for the base programs of research and to provide new resources for the competitive grants program.

In general, competitive grants have been made available for fundamental biological research that is critical to agriculture. Because of the basic nature of this work, the USDA's policy allows competition from both within and outside the traditional land-grant institutions. Scientific peers are actively involved in all phases of management, including helping to set the research agenda, evaluating proposals, awarding grants and evaluating progress.

The competitive grants program has also been quite dynamic. An early emphasis in plant sciences has broadened to include other areas of biological science. A major initiative in the area of biotechnology was proposed by the Administration and first funded by the Congress in FY85. The biotechnology initiative is still emerging with strong support by the White House Office of Science and Technology Policy and others in the Administration. The competitive grants program has undergone substantial growth; more than $55 million will be awarded in FY86. Thus, almost 20 percent ofthe USDA funds distributed to the states through the Cooperative State Research Service are now being awarded in the competitive grants program. These grants complement funding provided by other federal research agencies such as NSF, HHS, EPA and the Department of Interior, for broad, fundamental agricultural research.

NSF's Program Oversight Process
Report for FY 1985

nsf

OFFICE OF THE
DIRECTOR

February 25, 1986

NSB 86-45

MEMORANDUM TO MEMBERS OF THE NATIONAL SCIENCE BOARD

SUBJECT: Annual Report on the Foundation's Use of Peer Review

This report is submitted in accordance with the policy Regarding Peer Review Endorsed by the NSB at its 188th Meeting on March 17-18, 1977 and Amended at its 251st Meeting on March 15-16, 1984 which states:

> VI. The Director shall provide the Board no less than annually a report on the Foundation's use of peer review. This report shall include:
>
> A. A list of the standard classes of exemption from peer review and information on the waiver of peer review in other cases.
>
> B. Summary of external peer oversight committee reports.
>
> C. Recommendations for change or further consideration of the Foundation's policies on peer review.
>
> D. Such other information as the Director may feel appropriate.
>
> It is the policy of the National Science Foundation to make available, upon request, a list by division of all reviewers used during the preceding year.

The list of the standard classes of exemption from peer review is prescribed in NSF Manual 10 given in Attachment I. Although recast in a new format, the exemptions are the same as those given in the report presented last year except for the addition of the words "or under the auspices of international cooperative scientific programs" to exemption 3(b) covering proposals for certain conferences, symposia, and workshops. This change was made to facilitate planning conferences in international cooperative programs.

In FY 1985, there were three cases of special waiver of peer review. One was for the support of the NAS-NRC Numerical Data Advisory Board. Proposals for support of NAS-NRC Committees are usually reviewed by the appropriate NSF Advisory Committee, but in this case so many different disciplines are involved that such review would be impractical. The other two were Earth Sciences planning proposals for multi-institutional consortia to manage large projects. These were Incorporated Research Institutions for Seismology (IRIS) and Deep Observation and Sampling of the Earth's Continental Crust (DOESECC). Since each consortia involves essentially all of the institutions involved in these areas, reviewers would have conflicts of interests. Both projects have been discussed extensively by the Advisory Committee for Earth Sciences and the NSB Committee on Programs and Plans.

With my approval at the end of 1985, the Engineering Directorate announced that it would provide a limited amount of support for proposals of $30,000 or less that involve exploratory research without external peer review. This is an experimental approach, limited to no more than 5% of any program's FY 1986 budget. The objective is to provide a rapid response to proposals to explore innovative ideas. After about a year, this special procedure will be evaluated. The instructions issued by the Engineering Directorate are contained in Attachment II.

The annual summary of external peer oversight reports is contained in Attachment III.

There are no recommendations for changes in policies on peer review at this time.

Erich Bloch
Director

Attachments

tional guidelines must be applied.

a. *Criterion of Need.* Evidence should be provided, if a new administrative structure is proposed, that it is needed to address scientific problems in a manner or on a scale not possible with existing structures.

b. *Criterion of Long-Range Potential.* Evidence should be provided of a mission with such potential for high scientific productivity over an extended time period that a significant number of excellent scientists are willing to commit their careers to it.

122 Use of Peer Review

122.1 General Policy

The evaluations of formal proposals for NSF funding must include external (to the Foundation) peer review, with the following exceptions:

a. proposals submitted in response to those formal solicitations that are governed by the Federal Acquisition Regulations.

b. proposals to provide goods or services normally obtained through procurement mechanisms such as contracts, purchase orders, or requisitions.

c. proposals for which peer review has been waived by the Director or a designee. The responsible Assistant Director may, however, require peer review in particular cases. Situations for which peer review has been waived include:

1. the following cases which have been already effectively peer reviewed:

(a) incremental funding amendments (such as continuing grants) to awards within the time period and scope for which a prior commitment was made on the basis of external peer review.

(b) no cost extension of projects.

(c) supplements, as defined in PAM 404.5, including proposals submitted under international cooperative research programs for which support is requested to add an international dimension to an active domestic research project presently funded by NSF without significantly changing the nature and scope of the research.

(d) awards to cover increased costs due to changes in NSF grant administration requirements or indirect cost adjustments.

(e) awards for which funds are transferred to NSF by another agency to augment specific NSF awards.

(f) awards occasioned by a Principal Investigator's change of institution, provided there is no substantial increase in level of funding or change in project objectives.

(g) ship operations in support of peer reviewed projects.

(h) services to a scientific community, the nature, quality, scope and cost of which have been examined within three years prior to the award by the appropriate advisory committee. (A copy of the pertinent minutes will be included instead of reviews.)

2. The following cases where peer review is not applicable:

(a) proposals for Intergovernmental Personnel Act (IGPA) awards.

(b) services provided by another Federal agency in support of Polar Programs.

(c) modifications, improvements, or additions to ships in the academic fleet when required for reasons of safety.

(d) contracts and interagency agreements for surveys and data processing in support of the science resources statistics systems, for international scientific exchange programs and multinational scientific organizations, and for evaluation of fellowship candidates.

(e) proposals that (i) are not within the areas set forth for support in, or otherwise do not comply with the requirements of, the program announcement or solicitation under which they were submitted, and are not appropriate for transfer to other Foundation Programs; or (ii) are explicitly excluded by NSF policy as set down by the National Science Board or the Director, NSF (e.g., clinical medical research, foreign institutions not meeting the criteria of PAM 330 "Support of Research In, or In Cooperation With, Foreign Countries"). These proposals are returned to the proposer rather than being declined without peer review.

3. the following cases where peer review is impracticable or too costly:

(a) international travel grants either to an individual or an organization in support of a group.

(b) awards for conferences, symposia, and workshops where reviews cannot be obtained from persons who are both knowledgeable and uninvolved or which are undertaken for planning and assessment or under the auspices of international cooperative scientific programs.

(c) Logistic Support Only awards when no significant additional expenses are involved.

(d) proposals of less than $20,000 designed to capitalize on unexpected and short-lived natural phenomena when the responsible Assistant Director has determined that external peer review would result in a delay which would make the research unfeasible. (A copy of such determination is to be placed in the file instead of a review and copies of the determination are to be sent to the Director and the Division of Audit and Oversight.)

d. proposals which present an extraordinary problem in obtaining external peer reviews. (In these few cases the determination whether external review is required is made by the Director or designee on a case-by-case basis. A copy of the determination is placed in the file instead of a review.)

e. proposals which are withdrawn before decision.

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

OFFICE OF THE
ASSISTANT DIRECTOR
FOR ENGINEERING

AD/ENG BULLETIN NO. 85-25

GRANTS AND CONTRACTS November 20, 1985

SUBJECT: Expedited Awards for Novel Research

One of the goals of the Engineering Directorate is to provide an environment which will stimulate more creative and innovative engineering research. As part of this effort, the Directorate will provide a limited amount of support for proposals of $30,000 or less designed to capitalize on opportunities for exploratory research at academic institutions. Such research includes work on the initial elements of a subject in an emerging area of science or engineering, exploration of new ideas for cross-disciplinary approaches to research by investigators from different fields of science/engineering, or exploration of new methodologies for conducting basic research on current scientific and engineering problems. Proposals will be evaluated in a timely manner so that work can commence as soon as possible. The grants will have a duration of one year.

The Director has authorized the Engineering Directorate to conduct an experiment in making such awards without external peer review. The amount of funds that can be expended this way in any program is limited to 5% of the program's Fiscal Year 1986 current operating plan. This is an upper limit; the actual number of awards made in any particular program will depend on the quality of proposals received. These funds are not transferable among programs or divisions.

An announcement will be made to publicize this opportunity and explain procedures for submitting proposals to the research community. Proposals will have to meet the conditions set out in Grants for Scientific and Engineering Research (NSF 83-57) including a cover page, statement of other research support, and budget. The project description should be brief (no more than two pages) and include a discussion of the importance of the work, its exploratory nature, and why it is important that work proceed as soon as possible. Only 2 copies of the proposal are required. Investigators are encouraged to discuss their ideas with the appropriate Program Director either by letter or telephone prior to submitting a proposal.

If a Program Director receives a regular research proposal which might benefit from exploratory work, the Program Director can suggest that the proposer withdraw the existing proposal and resubmit an exploratory research proposal which would meet the guidelines of this initiative. Grants funded under these provisions are not renewable. However, a new proposal based on the exploratory work done under this grant may be submitted following the regular proposal submission procedures which require peer review.

All proposals for exploratory research will be logged into the MIS upon receipt. A special program reference code (9237) should be used to identify proposals as part of this special initiative. Procedures for processing exploratory research proposals will parallel those used for conferences/workshops that do not have review. A Form 7 shall be used and it shall contain a notation that this proposal is not subject to external peer review in accordance with Engineering Bulletin 85-25. In addition, there should be a discussion of the merits of the proposal which justify the proposed action (award or decline), and an explanation of why the Program Director believes the proposal meets the criteria for exploratory research. Proposals should be evaluated on the basis of the idea presented rather than the Program Director's personal knowledge of the P.I. Division Directors are expected to monitor this carefully. Any guidance concerning a particular proposal given to a Program Director prior to his/her recommendation for award or declination shall be in writing and included in the proposal jacket. It is expected that these proposals will be evaluated by the Program Officer within one month of receipt by NSF.

All jackets must be signed by the Division Director to indicate cognizance of the proposed action, to confirm that the topic of the award is appropriate for the program involved, and that correct procedures have been followed. The Division Director is expected to act on the Program Director's recommendation within 2 days. A copy of the Program Director's justification for recommending an award and the extra copy of the proposal should be forwarded to AD/ENG when the jacket is sent to the Division of Grants and Contracts.

Program Directors are encouraged to use this authority in appropriate circumstances to enable a quick response. It is expected that proposers who are to get an award will be notified by telephone by the Program Director. In institutions which have an Organizational Prior Approval System (OPAS) and which are prepared to exercise the 90 day pre-award provision, the principal investigator will be able to start as soon as the institution authorizes the 90 day pre-award process.

The experimental use of this procedure will be evaluated after it has operated for a period of time to decide whether or not it is effective in fulfilling the goal of establishing a more innovative and creative engineering research culture. Grantees will be requested to provide a brief final report which will summarize significant findings resulting from the exploratory work, and the principal investigator's assessment of what further work can be done on the research topic and the impact this work will have on its particular field of engineering. These reports will be used for publicity and to evaluate the merit of the program. Program Directors are expected to identify significant research results from these awards which can be used for publicity and forward these news items to Mrs. Mary Poats.

This procedure will be effective throughout Fiscal Year 1986.

Nam P. Suh
Assistant Director
for Engineering

Distribution:

NSF - E
ENG - F

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

ATTACHMENT III,
app. II

Division of Address and Oversight

MEMORANDUM

DATE: February 19, 1986

REPLY TO
ATTN OF: Director, DAO

SUBJECT: FY 1985 External Peer Oversight Reviews

VIA: Controller

TO: Director

Attached is the summary report on External Peer Oversight for FY 1985 prepared by the Division of Audit and Oversight.

J.H. Fregeau
Jerome H. Fregeau

Attachment

cc: Executive Council

NATIONAL SCIENCE FOUNDATION
WASHINGTON D C 20550

Division of Audit and Oversight

MEMORANDUM

DATE: February 19, 1986

REPLY TO
ATTN OF: Head, Oversight Section, DAO

SUBJECT: FY 1985 Summary of External Peer Oversight Reviews

TO: Director, DAO

The attached report fulfills the DAO responsibility, assigned in NSF Manual No. 1, ADM-VIII-300 (formerly NSF Circular No. 147), to prepare the annual summary of external peer oversight review for the Director to transmit to the NSB.

During FY 1985 external peer oversight committees reviewed 36 NSF programs and provided a positive evaluation of the technical stewardship for each.

James J Zwolenik
James J. Zwolenik

Attachment

February 18, 1986

SUMMARY

EXTERNAL PEER OVERSIGHT REVIEWS

FY 1985

Abstract

External peer oversight committees reviewed the technical management of 36 NSF programs and rendered a written, positive evaluation for each program.

Introduction

NSF Circular No. 147 on "External Peer Oversight" requires a triennial program review by an external peer oversight committee for each program in the Foundation.[1] The purpose of these reviews is to provide NSF management with an advisory appraisal of the technical stewardship in each program. External peer oversight committees transmit their reports to the Director throughout the fiscal year. Annually the Division of Audit and Oversight (DAO) prepares a summary of these external peer oversight reports for the Director to transmit to the National Science Board.

FY 1985 External Peer Oversight Reports

Thirty-six reports were received covering FY 1985 external peer oversight review findings. All reviewed programs appear in the left-hand column of Table 1 (attached) and are distributed among directorates as follows:

AAEO	5	MPS	10
BBS	15	SEE	0
ENG	4	STIA	2

Fifty-one reviews were scheduled by the directorates for FY 1985. Thirty-six were submitted giving a submission rate of 70%. Of the 15 scheduled but not submitted, 7 were not required until FY 1986 or later and represent no problem. Of the remaining 8, 3 programs in the Division of Information Science and Technology, BBS, were overdue in FY 1985 and 5 STIA programs (3 in the

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[1] On July 12, 1985 NSF Manual No. 1, ADM VIII, Subchapter 300, replaced NSF Circular No. 147. The substance of the requirements remains the same.

Division of Policy Research and Analysis and 2 in the Division of Science Resources Studies) were due in FY 1985. DAO has no record of approval for these 8 postponements. All eight delinquent programs have scheduled oversight reviews for FY 1986.

Completeness of the FY 1985 Reports

All reviews emphasize the technical (disciplinary) aspects of program management.

The review elements prescribed in NSF Circular No. 147 are column headings in Table 1, which is a check for completeness. Two of the 36 reports (6%) made no answer to one or more of the required questions in Element 3. This is only half the number of reports which omitted one or more questions in FY 1984. In general both the completeness and the quality of responses to required questions have improved noticeably over the last several years.

Generalizations and Notable Comments in the Peer Oversight Reports

The material presented below is divided into the constitutive elements required by NSF Circular No. 147 for each peer oversight report.

ELEMENT 1 - A BRIEF DISCUSSION OF THE WAY IN WHICH THE REVIEW WAS CONDUCTED.

Responses to this question indicate a variety of committee organizations and operations. Many committees held in-depth program briefings prior to studying jackets; others did not; and there was a distribution between these extremes. Program review committee size ranged between 2 (8 instances) and 11 members (1 instance). The median-size committee had 4 members. Most oversight reviews were performed by Foundation advisory committees or subcommittees augmented by a few additional experts to ensure breadth of review.

ELEMENT 2 - THE NUMBER OF JACKETS REVIEWED AND THE WAY IN WHICH THEY WERE SELECTED.

The number of jackets reviewed for a single research program ranged from 7 to 148. At least 1,260 jackets (lower limit) were reviewed.

No uniform procedure for sample selection operates across programs. The review committees designed their samples to address those points judged to be important in the programs.

ELEMENT 3 - THE ANSWERS TO THE SPECIFIC QUESTIONS ASKED IN 3.e. OF NSF CIRCULAR NO. 147--

(i) IS THE REVIEW PROCESS FUNCTIONING PROPERLY IN TERMS OF THE SELECTION OF AN APPROPRIATE NUMBER OF TECHNICALLY QUALIFIED REVIEWERS AND ADEQUATE QUALITY AND FREEDOM FROM BIAS OF THE REVIEWS? (NOT APPLICABLE TO NATIONAL CENTERS, LOGISTICS SUPPORT, ETC.)

All committees responded to this question. Their replies in general were positive.

One committee reported that review of "group proposals" did not follow NSF requirements. (DAO determined that documentation on group proposals may not have been as clear as possible in this program. The cognizant Division Director has introduced new documentation which shows explicitly how NSF requirements are being followed.)

Interestingly, about half of the committees also made one or more of the following points along with their positive responses:

- Low ad hoc reviewer response rate.
- Insubstantial character of some ad hoc reviews.
- Panel summaries not substantial, uninformative.

Although these three observations concern actions of the relevant research community, review committees also alerted NSF to insist on adequate numbers of "quality" reviews.

(ii) (a) ARE THE DECISIONS OF THE PROGRAM OFFICER UNDERSTANDABLE FROM THE DOCUMENTATION ACCOMPANYING A RECOMMENDATION?

(b) ARE THE DECISIONS APPROPRIATE AS TO AWARD OR DECLINATION AND AS TO SCOPE, DURATION, AND SIZE OF THE PROJECT?

(c) DID PROGRAM OFFICERS TAKE INTO ACCOUNT THE PI'S PERFORMANCE ON PRECEDING AWARDS? (DOCUMENTATION SHOULD BE IN THE GRANT FOLDER, SPECIFICALLY ON NSF FORM 7, "REVIEW RECORD.")

All committees responded to parts (a) and (b) of this question. For part (a) regarding documentation, the committees found the standard of documentation in program jackets ranged from acceptable to well-documented. Within this acceptable range, one committee cited some instances of document omission and sloppiness; another committee asked for fuller documentation to substantiate decisions on "border line" proposals; and another noted an unevenness in the review analysis on NSF Form 7.

For part (b) of this question on whether the program decisions were appropriate, no committee disagreed outright with any award or declination. However, one committee in reviewing two programs indicated that it "questioned" 2-3 decisions. This is the closest any committee came to disagreeing with a decision. These 2-3 represent 0.2-0.3% of the decisions reviewed in FY 1985. One committee found that the budget range on awards was rather narrow; and, another that some decisions on reduced budgets and on continuing versus year-by-year grants were not entirely clear.

Only 21 reviews addressed part (c) by commenting negatively or positively or by noting the application of this requirement for the future. This 60% response rate and the content of the response reflect the fact that the NSF official requirement for documentation on previously supported research was issued May 29, 1984--8 months into FY 1984 which was the base year for most of the external peer oversight reviews completed in FY 1985.

(iii) ARE ANY SIGNIFICANT IMBALANCES SEEN IN THE PROGRAM(S) UNDER REVIEW SUCH AS SIZE VERSUS NUMBER OF AWARDS, SUBJECT MATTER DISTRIBUTION OF AWARDS, AGE, OR GEOGRAPHIC DISTRIBUTION OF PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS?

The response rate here was 100%. Most found an "appropriate balance" or reported "no significant imbalances overall"--frequently adding "under current budgets." Some took this opportunity to identify new research areas which fall within the scope of the program and which deserve new and/or increased emphasis. Committees reviewing 5 programs in BBS found a "non-risk" bias in much of the funding. Six reviews advised that young investigators should not be penalized for their lack of experience; since there was no suggestion of such a bias, this remark is a cautionary warning.

(iv) WITHIN THE LIMITS OF ITS BUDGET, IS (ARE) THE PROGRAM(S) MEETING THE OBJECTIVES SET BY NSF? (IF POSSIBLE, OVERSIGHT REVIEW SHOULD COMMENT ON THE RESULTS COMING FROM THE PROJECTS SUPPORTED BY THE PROGRAM.)

Almost all replied "yes, within limitations of current budgets." Committee replies were frequently based upon individual judgments of the impact of NSF support on their fields--many times relying on journal publications. However, sometimes the basis of the committee judgment on impact wasn't explicitly stated. Some reported insufficient time and/or data to allow full or adequate consideration of the significance of results from projects sponsored by the program. Two program reviews failed to respond to this question; five made a partial response.

(v) ARE THERE ANY ADDITIONAL QUESTIONS WHICH SHOULD BE ADDRESSED IN AN OVERSIGHT REVIEW? (ASSISTANT DIRECTORS MAY WISH TO ASK ADDITIONAL QUESTIONS SUCH AS ONES RELATING TO THE BALANCE BETWEEN THE PROGRAM(S) UNDER REVIEW AND OTHER PROGRAMS IN NSF OR OTHER AGENCIES AND TO CHANGES TAKING PLACE IN A FIELD WHICH WILL AFFECT FUTURE PROGRAM BALANCE.)

In some instances, additional questions were posed to review committees and were answered within a program-specific context. In other instances, the review committee formulated its own questions and included replies here. Only 36% of the reports addressed additional questions.

ELEMENT 4 - AN OVERALL EVALUATION OF THE STEWARDSHIP OF THE FOUNDATION STAFF IN MANAGING THE PROGRAM.

Positive evaluation statements were made on the technical management of all programs under review. There were no indications of unsatisfactory technical management although there was one rather negative case. Overall, there was strong endorsement of the performance of the technical staff.

ELEMENT 5 - ANY OTHER POINTS THE OVERSIGHT COMMITTEE WISHES TO ADDRESS.

About 80% of the reviews mentioned matters of particular concern to the oversight committee. Most frequently these were elaborations or developments of points triggered by earlier questions. The topics were very diverse. In contrast to FY 1984 when the program reviews were principally concerned about more program funds, FY 1985 showed a much broader range of concerns.

DAO Conclusions/Recommendations

Based on the 36 External Peer Oversight Reviews received in FY 1985, DAO makes the following conclusions and recommendations:

1. NO MAJOR PROBLEMS WITH PEER REVIEW AND THE NSF DECISION-MAKING PROCESSES WERE IDENTIFIED IN THE FY 1985 EXTERNAL PEER OVERSIGHT REPORTS.

2. Oversight review reports have improved tremendously in presentation and usefulness over the last seven fiscal years. However, DAO feels that closer adherence to the report format specified in NSF Manual No. 1 would facilitate more complete communication between the oversight committee and NSF management.

> RECOMMENDATION: External peer oversight review committees should be strongly encouraged to observe the report requirements as set out in NSF Manual No. 1, ADM-VIII-360 and to format their reports according to these requirements.

3. Comparatively few review committees have received a set of questions related either to priority setting within or among programs or to the identification of changes which will affect the future balance in a program or among a set of programs.

> RECOMMENDATION: In view of management needs to establish priorities and to plan, Assistant Directors should consider more effective deployment of specific questions.

James J Zwolenik

James J. Zwolenik
Head, Oversight Section
Division of Audit and Oversight

Attachments - Table 1
NSF Circular No. 147

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PAGE

TABLE 1
Check of Contents, FY 1985 External Peer Oversight Reports: Requirements of NSF Circular No. 147, Sec. 3 (Policy), Part f (Reports)

	Element 1	Element 2	Element 3							Element 4
			SPECIFIC QUESTIONS							
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	(i)	(ii) a	(ii) b	(ii) c[2]	(iii)	(iv)	(v)[1]	Provided Overall Evaluation of Stewardship
AAEO										
ATM										
- Atmospheric Chemistry	X	X	X	X	X	O	X	X	X	X
- Climate Dynamics	X	X	X	X	X	O	X	X	O	X
- Experimental Meteorology	X	X	X	X	X	O	X	X	X	X
DPP										
- Polar Atmospheric Sciences	X	X	X	X	X	X	X	X	X	X
- Polar Biology and Medicine	X	X	X	X	X	X	X	X	X	X

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[1] NSF Circular No. 147 imposes no requirement on NSF management to ask additional questions nor for the review committee to pose any.

[2] NSF Circular No. 129 (Rev. 3) required program officers on May 29, 1984 to document their own evaluation of the quality of the investigators previous research accomplishments. This is well into FY 1984, the year most external oversight committees reviewed.

Division/ Program	Element 1	Element 2	Element 3							Element 4
	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS							Provided Overall Evaluation of Stewardship
			(i)	(ii)			(iii)	(iv)	(v)[1]	
				a	b	c[2]				
RBS										
BSR										
- Systematic Biology	X	X	X	X	X	X	X	X	O	X
- Biological Research Resources	X	X	X	X	X	X	X	X	O	X
BNS										
- Anthropology	X	X	X	X	X	O	X	X	X	X
SES										
- Law & Social Science	X	/	X	X	X	X	X	X	X	X
- Geography & Regional Science	X	X	X	X	X	O	X	X	O	X

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[1] NSF Circular No. 147 imposes no requirement on NSF management to ask additional questions nor for the review committee to pose any.

[2] NSF Circular No. 129 (Rev. 3) required program officers on May 29, 1984 to document their own evaluation of the quality of the investigators previous research accomplishments. This is well into FY 1984, the year most external oversight committees reviewed.

	Element 1	Element 2	Element 3							Element 4
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS (i)	(ii)			(iii)	(iv)	(v)[1]	Provided Overall Evaluation of Stewardship
				a	b	c[2]				
- Measurement Methods & Data Improvement	X	X	X	X	X	O	X	X	O	X
DCB										
- Eukaryotic Genetics	X	X	X	X	X	X	X	X	X	X
- Cell Biology	X	X	X	X	X	X	X	/	X	X
- Cellular Physiology	X	X	X	X	X	X	X	O	X	X
- Developmental Biology	X	X	X	X	X	X	X	/	X	X
- Regulatory Biology	X	X	X	X	X	X	X	O	X	X

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[1] NSF Circular No. 147 imposes no requirement on NSF management to ask additional questions nor for the review committee to pose any.

[2] NSF Circular No. 129 (Rev. 3) required program officers on May 29, 1984 to document their own evaluation of the quality of the investigators previous research accomplishments. This is well into FY 1984, the year most external oversight committees reviewed.

	Element 1	Element 2	Element 3							Element 4
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS (i)	(ii)			(iii)	(iv)	(v)[1]	Provided Overall Evaluation of Stewardship
				a	b	c[2]				
DMB										
- Biochemistry	X	X	X	X	X	0	X	/	0	X
- Biophysics	X	X	X	X	X	0	X	X	0	X
- Metabolic Biology	X	X	X	X	X	0	X	/	0	X
- Prokaryotic Genetics	X	X	X	X	X	0	X	X	0	X

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[2] NSF Circular No. 129 (Rev. 3) required program officers on May 29, 1984 to document their own evaluation of the quality of the investigators previous research accomplishments. This is well into FY 1984, the year most external oversight committees reviewed.

	Element 1	Element 2	Element 3							Element 4
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS (i)	(ii)			(iii)	(iv)	(v)[1]	Provided Overall Evaluation of Stewardship
				a	b	c[2]				
ENG.										
CBTE										
- Kinetics & Catalysis	X	X	X	X	X	O	X	X	O	X
- Multiphase & Interfacial Phenomena	X	X	X	X	X	O	X	X	O	X
- Thermodynamics & Transport Phenomena	X	X	X	X	X	O	X	X	O	X
- Thermal Systems & Engineering	X	X	X	X	X	X	X	X	O	X

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	Elem	Element 2	Element 3							Element 4
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS (i)	(ii) a	b	c[2]	(iii)	(iv)	(v)[1]	Provided Overall Evaluation of Stewardship
MPS										
DCR										
- Computer Systems Design	X	X	X	X	X	X	X	X	0	X
- Intelligent Systems	X	X	X	X	X	X	X	X	X	X
- Software Engineering	X	X	X	X	X	/	/	/	0	X
- Computer Research Equipment	X	X	X	X	X	X	X	X	0	X
- Software Systems Science	X	X	X	X	X	/	/	X	0	X
- Special Projects	X	X	X	X	X	X	X	X	X	X

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	Element 1	Element 2	Element 3							Element 4
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS							Provided Overall Evaluation of Stewardship
			(i)	(ii)			(iii)	(iv)	(v)[1]	
				a	b	c[2]				
DMR										
- Polymers	X	X	X	X	X	O	X	X	O	X
- Ceramics & Electronic Materials	X	X	X	X	X	X	X	X	O	X
- Metallurgy	X	X	X	X	X	X	X	X	O	X
PHY										
- Atomic, Molecular, & Plasma Physics	X	X	X	X	X	X	X	X	O	X

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	Element 1	Element 2	Element 3							Element 4
Division/ Program	Discussed How Review Conducted	Reported # Jackets Reviewed and How Selected	SPECIFIC QUESTIONS (i)	(ii)			(iii)	(iv)	(v)[1]	Provided Overall Evaluation of Stewardship
				a	b	c[2]				
STIA										
DRII										
- Minority Research Initiation	X	X	X	X	X	n/a	X	X	O	X
- Research Improvement in Minority Institutions	X	X	X	X	X	X	X	X	O	X

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Key to Table 1:

Programs under review appear in the far left column. An "X" indicates the element is fully covered in the review committee's report; "/" means part of the element is in the report; and "0" means the element is missing from the report.

For specific question (v) under Element 3 additional questions were not always suggested by NSF or by the oversight committee so that the absence of any answer to this question does not necessarily mean that the review committee failed to address part of its task. Similarly the opportunity for the committee to address other points under Element 5 was not always used and for this reason Table 1 does not report on Element 5.

NATIONAL SCIENCE FOUNDATION

Office of the Director

Washington, D. C. 20550

NSF CIRCULAR NO. 147
(Revision 1)

ADMINISTRATION AND MANAGEMENT April 24, 1984

Subject: **External Peer Oversight**

1. **Purpose.** This Circular sets forth the guidelines for external peer oversight of Foundation programs.

2. **Cancellation.** This Circular cancels NSF Circular 147, dated January 17, 1979.

3. **Policy.**

a. *General Policy.* Each program shall be reviewed periodically by outside experts knowledgeable in the area of the program in order to provide NSF management with an advisory appraisal of the technical, as distinct from the administrative, stewardship by the NSF. This review is in addition to the peer reviews of particular proposals.

b. *Oversight Committee Membership.* Foundation advisory committees or panels (or subgroups), augmented by additional experts when needed to ensure adequate review, may be used to perform oversight review. If an ad hoc group is used, members should be selected in accordance with the criteria for selection of advisory committee members described in NSF Circular 132, "Peer Review and Guidelines for the Evaluation of Proposals." It is desirable that one or more of the experts be from subareas other than the subarea being reviewed to ensure that the review is conducted in the context of related Foundation programs (e.g., an experimental physicist should be part of the group reviewing the Theoretical Physics program). Members of the review groups will be appointed in the same manner as members of advisory committees. Membership of these committees will be published in the *NSF Annual Report.*

c. *Review Cycle.* Each program shall be reviewed at least once every 3 years. At the beginning of each fiscal year, Assistant Directors will prepare a plan for the reviews to be conducted that year and submit this plan to the Director after discussion with the Office of Audit and Oversight. The plan will include a list of all of the programs of the Directorate, month and year when each was last reviewed, the expected schedules for the reviews to be conducted during the year, identification of the reviewing group, and the expected year of the next review for those programs not being reviewed during the current year.

Where the NSF program structure is not an appropriate subdivision for a review of this type, the plan submitted by an Assistant Director will describe the scope of each oversight review (e.g., Arctic and Antarctic Geology).

d. *Access to Files.* Committees assembled for program oversight will have access to all program documentation, including proposal jackets on which action has been completed, and will review a sample of the awards, declinations, and withdrawals at the beginning of each meeting. Committee members will be reminded that the names and comments of ad hoc reviewers must remain confidential. No committee members shall review any jacket from the same institution employing the committee member.

e. *Specific Questions.* Specific questions will be developed and sent to the committee before each review to provide a framework for the review. The substance of the following questions will be included in all cases:

(1) Is the review process functioning properly in terms of the selection of an appropriate number of technically qualified reviewers and adequate quality and freedom from bias of the reviewers? (Not applicable to national centers, logistics support, etc.)

(2)(a) Are the decisions of the Program Officer understandable from the documentation accompanying a recommendation?

(2)(b) Are the decisions appropriate as to award or declination and as to scope, duration, and size of the project?

(2)(c) Did Program Officers take into account the PI's performance on preceding awards? (Documentation should be in the grant folder, specifically on NSF Form 7, "Review Record.")

(3) Are there any significant imbalances seen in the program under review such as size versus number of awards, subject matter distribution of awards, age, or geographic distribution of Principal Investigators/Project Directors?

(4) Within the limits of its budget, is the program meeting NSF objectives? (If possible, oversight review should comment on the overall impact of the program and the important results coming from the projects supported by the program.)

(5) Are there any additional questions that should be addressed in this oversight review? (Assistant Directors may wish to ask additional questions such as ones relating to priority setting, the balance between the program under review and other programs in NSF or other agencies and to changes taking place in a field which will affect future program balance.)

f. *Reports.* The oversight committee will report in writing to the Director and to the Assistant Director responsible for the program. A copy of the report will be sent to the

Office of Audit and Oversight. The report is to include:

(1) a brief discussion of the way in which the review was conducted;

(2) the number of jackets reviewed and the way in which they were selected;

(3) the committee's replies to the specific questions asked in 3e;

(4) an overall evaluation of the technical stewardship of the Foundation staff in managing the program; and

(5) any other points the oversight committee wishes to address.

Prior to formal submission of a report, a draft shall be examined by the cognizant NSF staff in order to arrange for correction of any factual errors. The staff shall prepare comments on the report and its conclusions. If desired by an Assistant Director, these comments may be attached to the report.

These reports will be submitted within 90 days of the meeting of the oversight committee, or if the review is made by other than an advisory committee and is to be commented on by the appropriate advisory committee, within 60 days of the meeting of the advisory committee.

g. *Availability of Reports.* The reports will be provided to the program staff and the appropriate advisory committee and will be made available to the scientific community and to the public upon request. Copies are filed with the Library of Congress for public inspection and use. Assistant Directors may wish to arrange additional publication or dissemination.

h. *Annual Summary.* Each year a summary report on the oversight reviews will be prepared by the Office of Audit and Oversight for the Director to transmit to the National Science Board as part of the Director's annual report on Foundation use of peer review.

4. **Responsibilities.**

a. Each Assistant Director is responsible for:

(1) planning and conducting oversight reviews of the programs in his or her Directorate;

(2) transmitting the Directorate annual oversight review plan to the Director with a copy to the Office of Audit and Oversight;

(3) ensuring that the requirements of the Federal Advisory Committee Act, Public Law 92-463 (5 U.S.C. App. 1), are followed (see NSF Circular 109, "Advisory Committee Management");

(4) transmitting oversight committee reports to the Director with a copy to the Office of Audit and Oversight and 10 copies to the Committee Management Officer (DPM) for transmittal to the Library of Congress; and

(5) preparing an appropriate response to the oversight committee under his or her cognizance.

b. Director, Office of Audit and Oversight, is responsible for:

(1) advising Assistant Directors and their staffs on oversight procedures;

(2) monitoring the external peer oversight process;

(3) preparing a composite schedule of Directorate oversight plans; and

(4) preparing the annual summary of external peer oversight for the Director to transmit to the National Science Board.

Edward A. Knapp

Edward A. Knapp
Director

Distribution: E
Originating Unit: Office of Audit and Oversight

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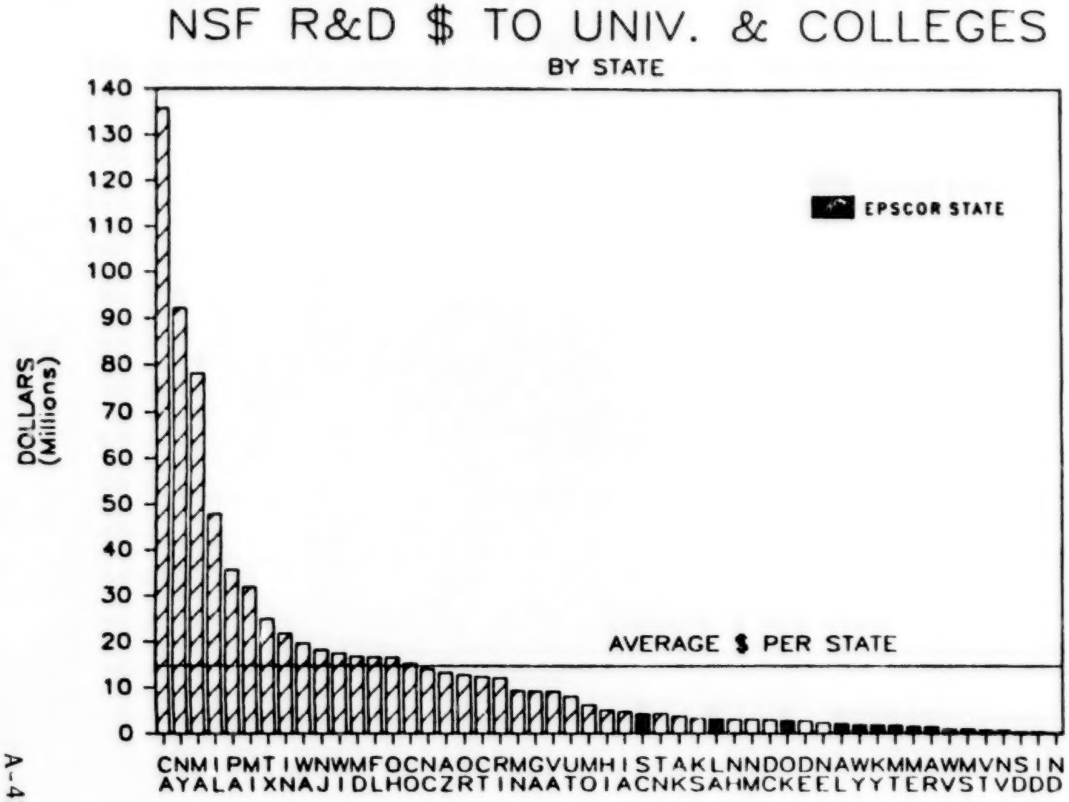
NATIONAL SCIENCE FOUNDATION ANALYSIS
GEOGRAPHIC DISTRIBUTION OF AGENCY FUNDING

The following charts are all based on the relative distribution of 1983 R & D funds of the National Science Foundation. The measure chosen to distribute these funds differs; the first two are commonly used to measure the relative equity of NSF's funding patterns against some standard other than science. The fourth, and last, is a presentation of the impact of NSF's standard for research excellence on its funding distribution. The third, the number of scientists and engineers, is an attempt at a halfway measure.

The substance of the analysis displayed by Charts 2, 3, and 4 is that when viewed against a number of different, but significant parameters, the distribution of NSF funding is clearly more equitable than Chart 1 would lead one to conclude. The data on Charts 2, 3, and 4 show that almost half of the states exceed or meet the average funding level indicated. Further, in many of those states where funding levels are significantly below the average, NSF is making a concerted effort to assist in the improvement of the scientific and engineering research and education infrastructure through such activities as the Experimental Program to Stimulate Competitive Research and enhanced support levels for undergraduate institutions in both the research and education activities of the Foundation.

CHART 1 of 4



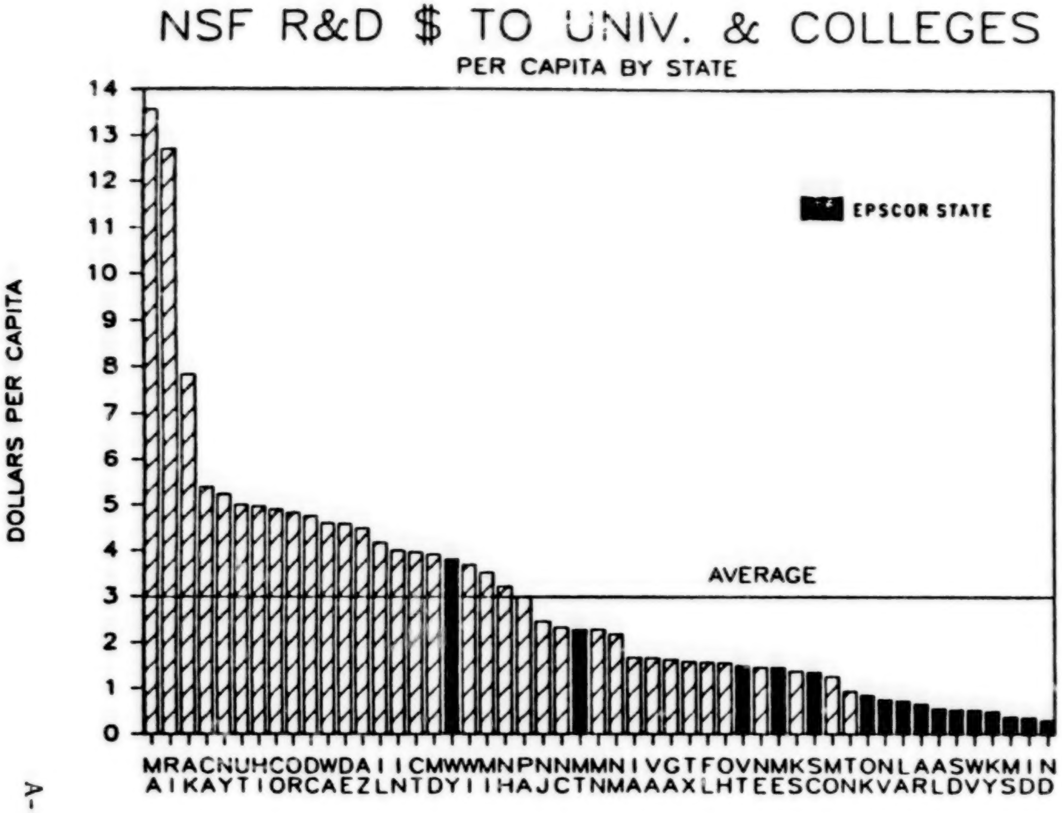
NSF R&D FUNDING TO UNIVERSITIES

AND COLLEGES BY STATE

- States are arrayed in order of receipts of 1983 NSF R&D dollars to universities and colleges.
- California, New York, Massachusetts, and Illinois are the high recipients.
- EPSCOR states represented by solid bars.

SOURCE: National Science Foundation Feb. 1986

CHART 2 of 4

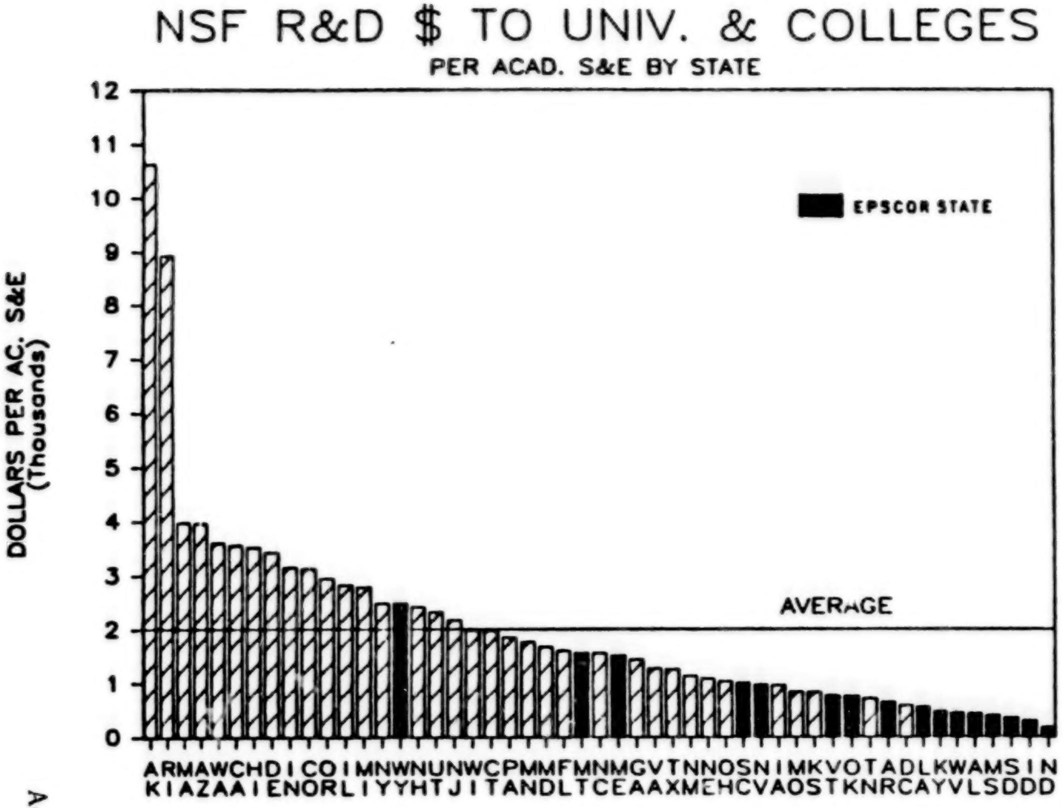


NSF R&D FUNDING TO UNIVERSITIES AND COLLEGES PER CAPITA BY STATE

- Same NSF funding data divided by each state's population. Plotted in in descending order of per capita state funding.
- The high states are Massachusetts ($13.56/capita), Rhode Island, Alaska, California, New York, Utah, and Hawaii.
- States represented by solid bars are the states being assisted through EPSCOR.
- Twenty-two states exceed or meet the average including such states as Delaware, Arizona, Wyoming, and New Hampshire.

SOURCE: National Science
Foundation Feb. 1986

CHART 3 of 4



NSF R&D FUNDING TO UNIVERSITIES AND COLLEGES PER ACADEMIC SCIENTIST AND ENGINEER

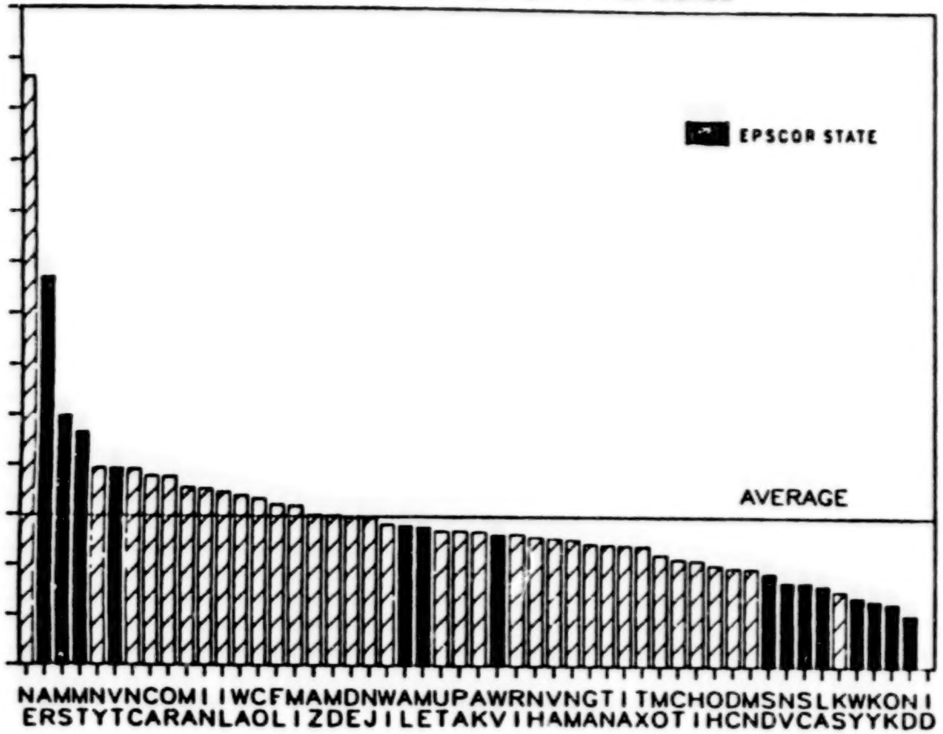
- NSF R&D funding divided by the number of academic scientists and engineers in each state, arranged in descending order.
- The high states are Alaska, Rhode Island, Massachusetts, and Arizona.
- States represented by solid bars are the states now being assisted through EPSCOR.
- Twenty states exceed or meet the average including such states as Colorado, Minnesota, and Utah.

SOURCE: National Science
Foundation Feb. 1986

NSF R&D $ TO UNIV. & COLL. BY STATE

PER INDEX OF HIGH QUALITY PROPOSALS

CHART 4 of 4



NSF R&D FUNDING TO UNIVERSITIES AND COLLEGES DIVIDED BY NUMBER OF HIGH RATED PROPOSALS PER STATE

(PROPOSAL QUALITY INDEX)

- Total NSF R&D funding per state (1983) divided by the number of high-rated* proposals from each state in a sample of 3200 proposals reviewed in 1980, 1981, and 1982.
- The chart shows that, in general, NSF's allocation of R&D allocation of R&D obligations to academic institutions is proportional to the highly rated proposals coming from a state.
- States represented by solid bars are the states being assisted through EPSCOR.
- Nineteen states exceed or meet the average including such states as Nebraska, Arkansas, Mississippi, Montana, Florida, and North Carolina.

SOURCE: National Science Foundation Feb. 1986

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* "High-rated" = N highest-rated proposals in each Division where N = number of awards in that Division. The total is 1222.

APPENDIX IV

Short bibliography of empirical studies of NSF peer review

Wilson, M.K., "The Top Twenty and the Rest: Big Chemistry and Little Funding," Annual Review of Physical Chemistry 26: 1-16, 1975.

D. Hensler, "Perceptions of the NSF Peer Review Process: A Report on a Survey of NSF Reviews and Applicants," prepared for the Committee on Peer Review of the National Science Board, 1976.

"Reviewer and Proposer Similarity and Its Effect on Award Decision," NSF Evaluation Staff Studies 76-1.

Cole, S., L. Rubin and J.R. Cole, Peer Review in the National Science Foundation, Phase One of a Study (Washington, D.C.: National Academy of Sciences, 1978).

DeWitt, T., R.S. Nicholson, and M.K. Wilson, "Science Citation Index and Chemistry," Scientometrics 2(4): 265-275, 1980.

Cole, J.R., and S. Cole, Peer Review in the National Science Foundation, Phase Two of a Study (Washington, D.C.: National Academy of Sciences, 1981).

"Geographic and Institutional Effect on the Award Decision," NSF Evaluation Staff Studies 81-2.

"A Study of the Fairness of the NSF Award Decision Process," NSF Evaluation Staff Studies 82-1.

Wall, R., "Peer Review in the Ocean Sciences Research Section of the National Science Foundation," EOS 63(December 7):1202, 1982.

"Fairness of the NSF Award Decision Process," NSF Evaluation Staff Studies 84-1.

"The NSF Post-performance Evaluation Study," NSF Evaluation Staff Studies 84-2.

"Fairness of the NSF Award Decision Process," NSF Evaluation Staff Studies 85-1.

Porter, A.L. and F.A. Rossini, "Peer Review of Interdisciplinary Research," Science, Technology, and Human Values 10(3), summer 1985.

APPENDIX V

COMPOSITION OF NSF ADVISORY COMMITTEES

(Data as of November 30, 1985)

January 1986

Prepared by the
Division of Personnel
and Management

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INTRODUCTION

The Third report on the composition of NSF advisory committees and panels contains data as of November 30, 1985. The two previous reports contained data as of March 31, 1985 and September 30, 1984. All data were provided by committee management contacts of NSF advisory committees and panels, whose assistance is greatly appreciated.

The report is divided into two parts: (1) analyses and summaries and (2) aggregated data and input sheets. With the advent of personal computers, the data have been manipulated with a greater depth and breadth of analysis than in previous reports. A large amount of Part I includes computer-produced charts and statistical computations and analyses of these data.

Questions about this report should be addressed to Gail McHenry, Management Analysis Section, Division of Personnel and Management, 357-9520.

TECHNICAL NOTES

There are six questions in the report input sheet. Below is the description of the source and definitions.

1. Field of Study. There are 17 major fields and an "other" category. The fields are based on the Central Personnel Data File (CPDF) and were modified for applicability to NSF.

2. Geographic Region. The five regions are:

NORTHEAST - NY, NJ, PA, CT, ME, MA, NH, RI, VT.

SOUTH - DE, DC, MD, VA, WV, NC, SC, GA, FL, AL, LA, KY, MS, TN, TX, AR, OK.

WEST - AK, CA, HI, OR, WA, ID, AZ, CO, MT, NM, UT, WY, NV.

MIDWEST - IA, KS, MO, MN, NE, ND, SD, IL, IN, MI, OH, WI.

FOREIGN - Any country outside the 50 United States.

3. Age of Members. The age category is divided into "under 40 years" and "40 years and over."

4. Sex, Race, and Handicapped.

a. Sex. Self-explanatory, programs classify members.

b. Race. Race of members is reported using the following Office of Personnel Management (OPM) categories:

American Indian or Alaskan Native: A person having origins in any of the original peoples of North America, and who maintains cultural identification through community recognition or tribal affiliation.

Asian or Pacific Islander. A person having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands. This area includes, for example, China, Japan, India, Korea, the Philippine Islands, and Samoa.

Black, not of Hispanic Origin. A person having origins in any of the black racial groups of Africa. Does not include persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish cultures or origins (see Hispanic).

Hispanic. A person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish cultures or origins. Does not include persons of Portuguese culture or origin.

White, not of Hispanic Origin. A person having origins in any of the original peoples of Europe, North Africa, or the Middle East. Does not include persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish cultures or origins (see Hispanic). Also includes persons not included in other categories.

c. Handicapped. Based on the OPM definitions, "handicapped" includes persons with: speech, hearing, and vision impairments: missing extremities; nonparalytic orthopedic impairments: and partial or complete paralysis.

5. Affiliation. The categories in affiliation are based on the NSF code compendium, "Institutional/Technical Reference File (ITRF)," and refined with "predominantly undergraduate institutions (PUI's)" and more distinct non-academic institutions such as "research institutes" and "National centers." The definition of PUI's is based on information provided by the Division of Research Initiation and Improvement (RII), STIA. DPM reviewed initial classification provided by programs in accordance with the ITRF and with RII and adjusted classifications where necessary.

6. Top 10 Institutions. This consists of 10 academic institutions which ranked in the top 10 for annualized dollar amount of NSF awards. The FY 1984 and FY 1985 top 10 are the same although the relative ranking changed. The rankings for FY '84 and '85 are:

FY 1984

1. MIT
2. University of California at San Diego
3. Cornell
4. University of Illinois at Urbana
5. Columbia
6. Stanford
7. University of Washington
8. University of California at Berkeley
9. University of Wisconsin at Madison
10. Cal Tech

FY 1985

1. MIT
2. Cornell
3. University of Illinois at Urbana
4. University of California at San Diego
5. University of California at Berkeley
6. Columbia
7. Stanford
8. University of Washington
9. Cal Tech
10. University of Wisconsin at Madison

COMPOSITION OF NSF ADVISORY COMMITTEES
ANALYSIS

1. **Total Number of Members.** The November 30, 1985 reporting period shows an 11.7% (77 members) increase in total membership over the March reporting period. This is due primarily to the appointment of additional members to the Engineering Directorate committees.

2. **Typical Member.** There is little change in the "typical member" profile. Below are the data as of November 30, 1985:

White (92%)
Male (82%)
40 Years Old or Older (79%)
From an Academic Institution (73%)
From the Northeast (34%) or West (27%), and
Not Handicapped (99%).

3. **Race of Members.** The proportion of Blacks and Asians/Pacific Islanders has grown since March '85 and the percentage of Blacks has increased in each reporting period (2.7%, 2.9%, 3.3%). Hispanic representation, on the other hand, has decrease from 13 to 8 members. In March, we reported three American Indian/ Alaskan members which increased to four in November.

See chart 1 (page 6) for statistics comparing non-white representation during the three reporting periods and chart 2 (page 7) for a display of the four committees reporting the largest proportion of non-white members.

4. **Handicapped Members.** There are five handicapped members, a decline of one since the last reporting period.

5. **Affiliation.** The primary affiliation of NSF advisory committee/panel members is the academic institution. However, the proportion has decreased slightly during this reporting period (from 76% in March '85 to 74%).

a. Academic Representation. Over the three reporting periods, representation from the top 10 schools (in terms of NSF awards) has steadily increased while the percentage of members from other academic institutions and predominantly undergraduate institutions (PUI's) has declined. (See chart 4 on page 9 for a comparison of distribution of academic membership over the three reporting periods.)

(1) Top 10. The first pie chart on chart 5 (page 10) shows the contribution of each directorate to the representation of top 10 schools. The percentages from the directorates closely resembled their proportion of members to the total membership except STIA which contributed less proportionately and MPS which contributed more.

Of all the directorates, MPS had the largest percentage from top 10 schools (30%) and BBS reported the most members (47) from the top 10. Over the three reporting periods, there has been a steady decline in representation from the University of California at Berkeley while representation from the other schools has fluctuated.

(2) Predominantly Undergraduate Institutions (PUI's). Over the three reporting periods, membership from PUI's has decreased slightly. (See chart 4 on page 9.) The table on Chart 5 (page 10) shows the organizational representation from PUI's (12 members).

(3) Other Academic Affiliation. This category consists of members from academe who are not included in the top 10 schools or PUI's. BBS represents the largest proportion of members from "other academic" organizations (about 73% of BBS membership). AAEO reported about half of its membership in this category (49%). The remaining directorates reported between 25% to 44% of their membership as "other academic."

b. Nonacademic Representation. Almost 27% of the membership is affiliated with an organization other than an academic institution. See chart 6 (page 11) for depiction of the nonacademic membership over the three reporting periods. Below is a description of members from the largest categories.

(1) Large Corporations. Except for the representation of government in March 1985, large corporations have dominated the nonacademic membership. In fact, this category represents almost double the percentage over the last reporting period (from 6% to almost 11%). The most significant representation during this reporting period is from Bell Labs (16% of the large corporation members) and du Pont, Exxon, and IBM (5% each of the large corporation membership). The remaining number of members affiliated with large corporations (54 members) represent 42 other organizations.

Almost half of the representation from large corporations (44% of total representation) serves on the Engineering committees. The next two highest percentages from large corporations (14% each) are from committees reporting to MPS and the Offfce of the Director. STIA contributes 12% of the total members from large corporations, representing 22% of STIA's members.

(2) **Government.** This category represents a consolidation of several governmental organizations: Federal government, State and local government, and government laboratories. Government affiliation represents 22% of the nonacademic membership. The total government representation dropped steadily from around 8% to 6%. The only component of the government figure that did not decrease from '84 to this reporting period was State and local government which doubled its representation.

Approximately 25% of the government representation is from BBS committees and panels, accounting for 4% of BBS' total membership. The Advisory Committee for SEE and committees reporting to the Office of the Director represent the greatest proportion of their membership from all components of government (13% each).

(3) **Research Institutes.** Representation from the research institutes has fluctuated over the reporting periods. This reporting period shows a decline of almost 2% of the membership. The largest representation (three members) is from Woods Hole Oceanographic Institution. The remaining 27 members are from 22 different research institutes.

Almost half of the members from research institutes serve on the BBS committee and panels, amounting to 4.5% of BBS' membership. The largest percentage of research institutes' representation in a directorate is in ADM where 21% (or 6 members) of ADM members are from research institutes.

6. **Geographic Distribution.** Chart 7 (page 12) shows the slight changes in representation from the four geographic regions. The South and foreign countries have steadily declined while the other regions have fluctuated. Northeast still represents the largest percentage followed by West, together comprising over half of the membership.

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SUMMARY OF NSF ADVISORY COMMITTEES

Number of Advisory Committees and Panels

		Type of Committee/Panel		
Sponsoring Organization	Total (% of TOT)	Program Advice	Ppl/Appl Review	Cognizant Office
Office of the Director	4	3		Office of the Director
	6.2%	1		Ofc/Advcd Sci. Computing
ADM	2		2	ADM (DPM)
	3.1%			
AAEO	7	5		Division level
	10.8%		1	OCE/OSR Section
			1	EAR Sections
BBS	34	1		AD/BBS
	52.3%		33	Section/Program level
ENG	8	1		AD/ENG
	12.3%	4		Division level
		2		Section level
			1	Ofc/Interdiscp. Res.
MPS	5	5		Division level
	7.7%			
SEE	1	1		AD/SEE
	1.5%			
STIA	4	3		Division level
	6.2%	1		EVIST Program
TOTAL NSF	65	27	38	
Percentage	100.0%	41.5%	58.5%	
Totals from	65	26	39	
March '85	100.0%	40.0%	60.0%	

TOTAL NSF STATISTICS

736

(No. Members)

NSF ADVISORY COMMITTEE MEMBERSHIP
NATIONAL SCIENCE FOUNDATION

1. Field of Study

%	# Members	Study Category
0.0%		Ag. & Natural Resources
31.5%	232	Biological Science
0.7%	5	Business & Management
1.9%	14	Computer & Info. Science
0.7%	5	Education
17.5%	129	Engineering
1.1%	8	Health Professions
0.1%	1	Law
3.9%	29	Mathematics
7.5%	55	Physics
6.8%	50	Chemistry
1.9%	14	Astronomy
1.9%	14	Atmospheric Sci
5.2%	38	Earth Science
2.2%	16	Ocean Science
3.5%	26	Psychology
7.5%	55	Social Sciences
6.1%	45	Other
100.0%	736	Total

2. Geographic Region

%	# Members	Region
34.0%	250	Northeast
21.9%	161	South
26.9%	198	West
16.8%	124	Midwest
0.4%	3	Foreign
100.0%	736	Total

3. Age of Members

%	# Members	Age
21.2%	156	Under 40 Years
78.8%	580	40 Years and Over
100.0%	736	Total

4. Sex, Race & Handicapped

SEX	A Ind/Als	Asian/PI	Black	Hispanic	White	Total	%	Hand'cpd
Male	4	15	20	6	564	609	82.7%	3
Female		8	4	2	113	127	17.3%	2
# Members	4	23	24	8	677	736		5
%	0.5%	3.1%	3.3%	1.1%	92.0%	100.0%	100.0%	0.7%

5. Affilation

%	# Members	Affiliation
1.6%	12	Predom. Undergrad. Inst.
71.5%	526	Other Academic Inst.
4.1%	30	Res. Inst.
10.6%	78	Large Corp.
1.8%	13	Small Business
2.3%	17	Fed. Govt.
1.1%	8	State/Local Govt
1.8%	13	Govt. Lab
0.3%	2	National Center
2.4%	18	Nonprofit Inst.
1.5%	11	Individual
1.1%	8	Other
100.0%	736	Total

6. Representation from Top Institutions

%	# Members	Top 10 Academic Institutions
1.8%	13	MIT
1.8%	13	U/C @ San Diego
1.1%	8	Cornell
1.4%	10	U/IL. @ Urbana
1.5%	11	Columbia
1.4%	10	Stanford
2.2%	16	U/Washington
2.2%	16	U/C @ Berkeley
1.9%	14	U/Wisc. @ Madison
1.2%	9	Cal. Tech.
16.3%	120	Total

(Data as of November 30, 1985)

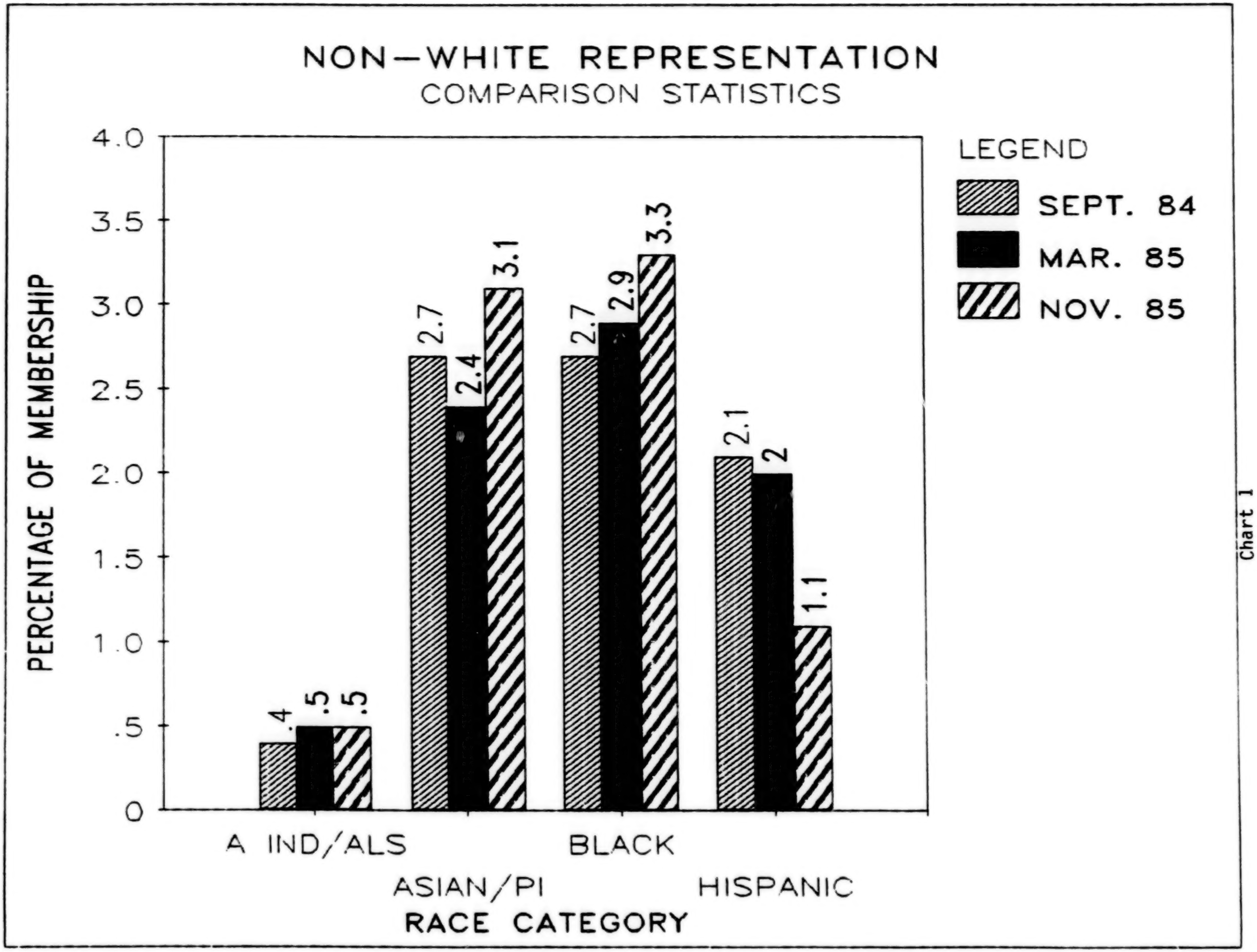

NON–WHITE REPRESENTATION
COMPARISON STATISTICS
PERCENTAGE OF MEMBERSHIP
4.0
3.5
3.0
2.5
2.0
1.5
1.0
.5
0
.4
.5
.5
2.7
2.4
3.1
2.7
2.9
3.3
2.1
2
1.1
A IND/ALS
ASIAN/PI
BLACK
HISPANIC
RACE CATEGORY
LEGEND
▨ SEPT. 84
■ MAR. 85
▨ NOV. 85

Chart 1
A-56

COMMITTEES WITH HIGHEST PERCENTAGE OF NON-WHITE MEMBERS

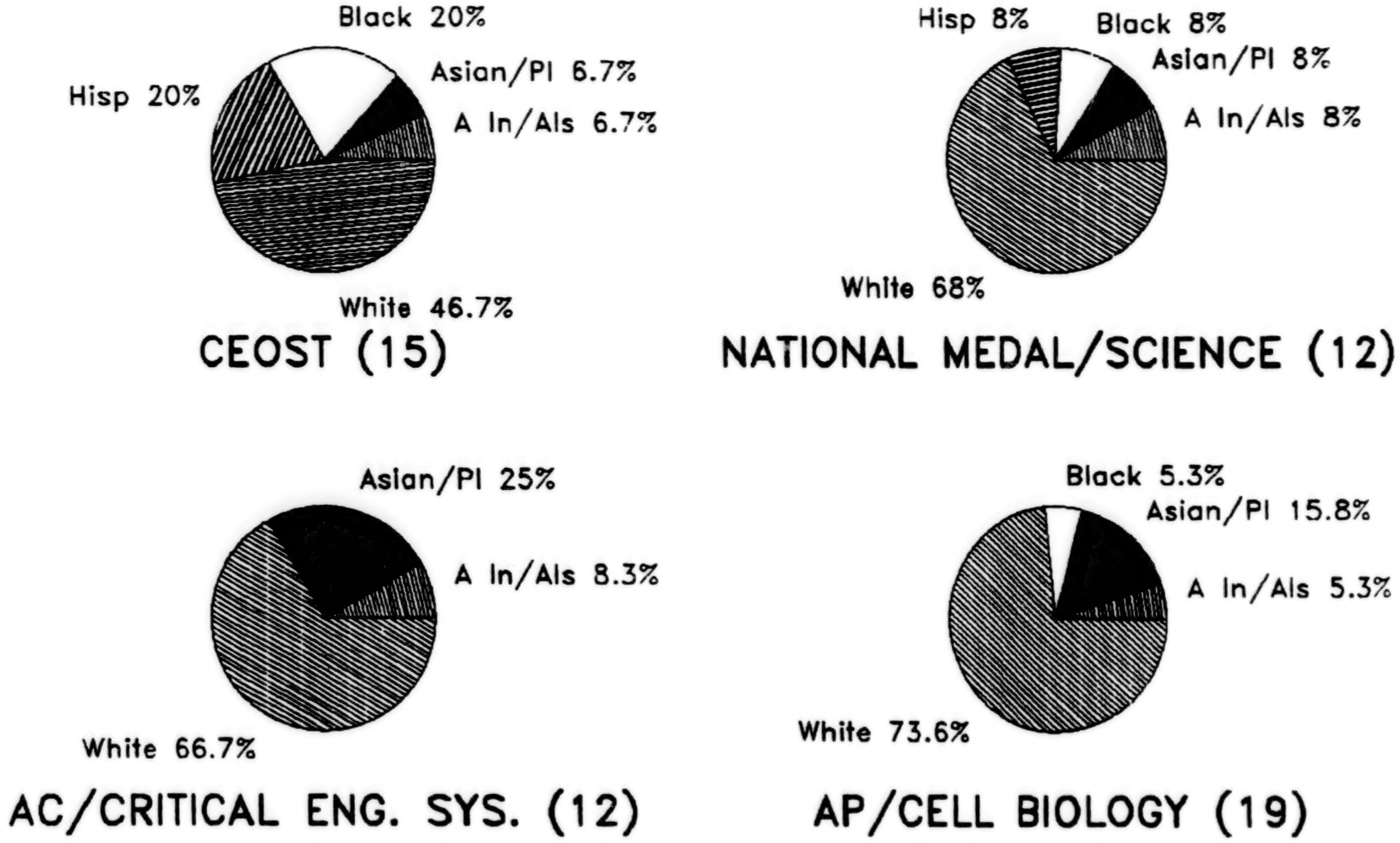
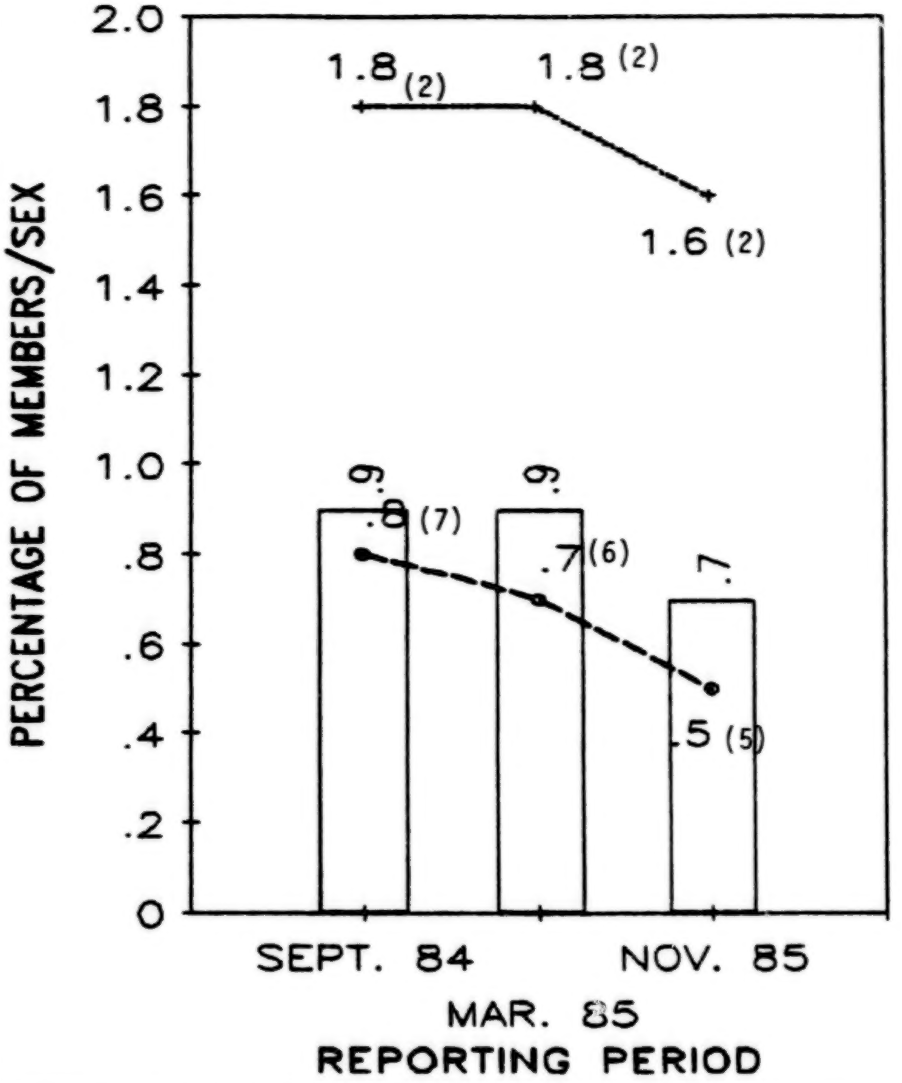


Chart 2
A-57

HANDICAPPED MEMBERS BY SEX
COMPARISON STATISTICS



NUMBER OF MEMBERS BY SEX

	9/84	3/85	11/85
Male	654	547	611
Female	113	112	125
TOTAL	767	659	736

Chart 3

A-58

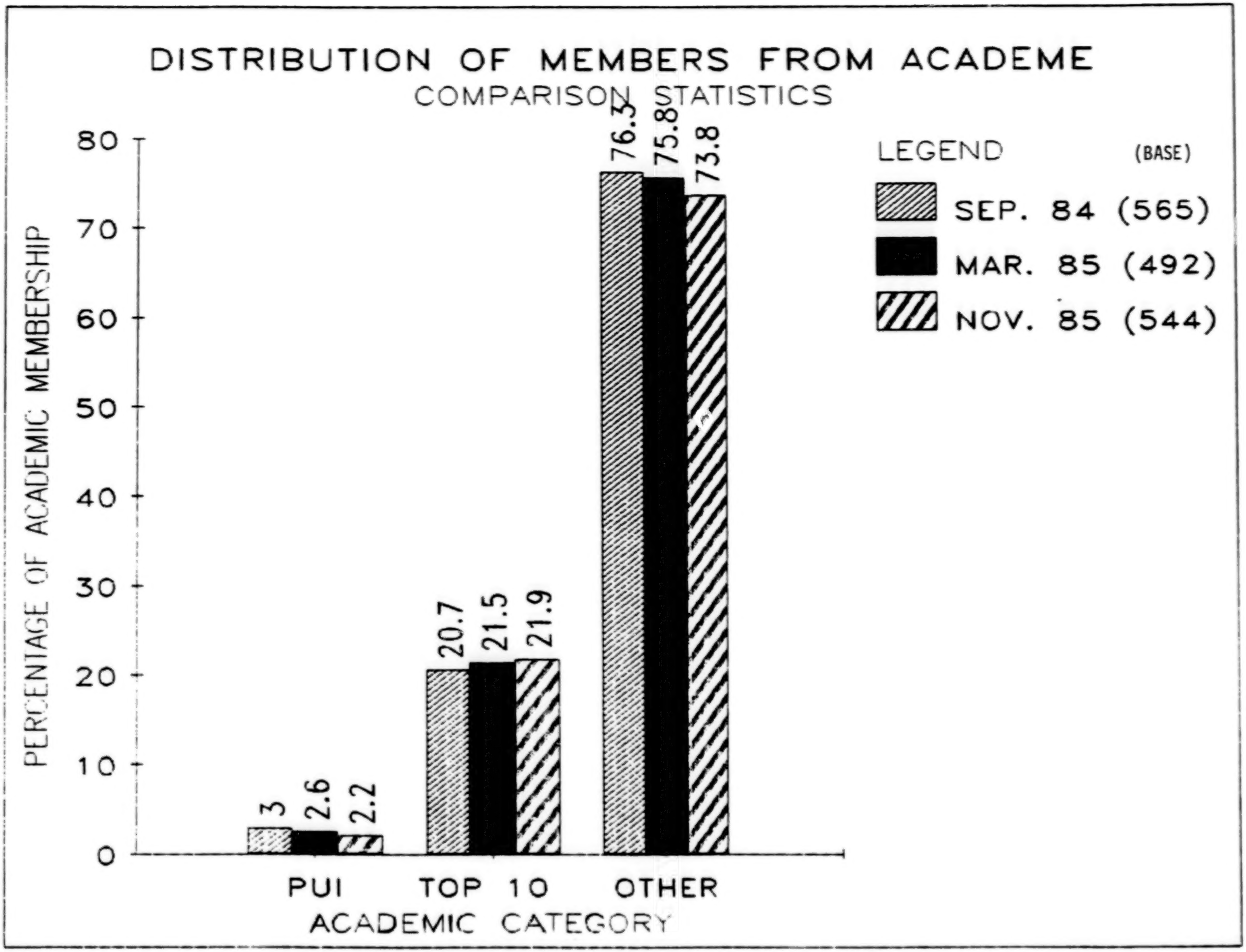
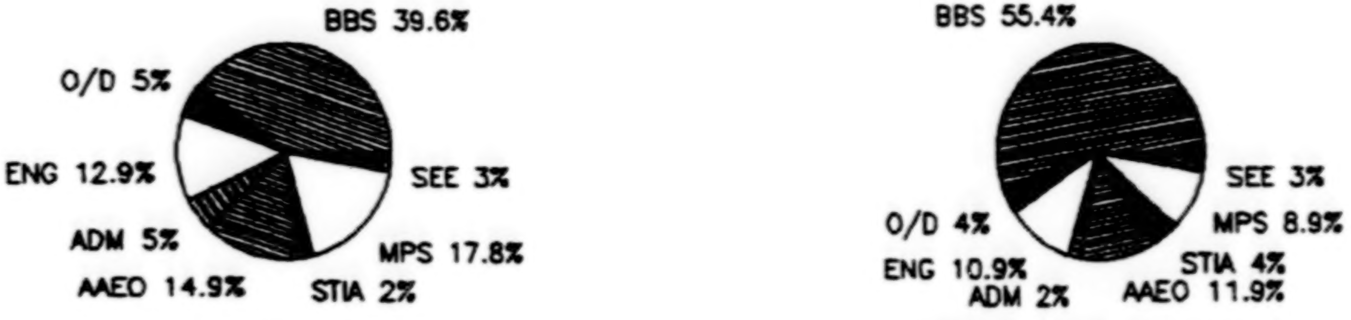

DISTRIBUTION OF MEMBERS FROM ACADEME
COMPARISON STATISTICS
PERCENTAGE OF ACADEMIC MEMBERSHIP
0
10
20
30
40
50
60
70
80
3
2.6
2.2
20.7
21.5
21.9
76.3
75.8
73.8
PUI
TOP 10
OTHER
ACADEMIC CATEGORY
LEGEND
(BASE)
SEP. 84 (565)
MAR. 85 (492)
NOV. 85 (544)

Chart 4
A-59

ACADEMIC MEMBERSHIP
(538 Members)



TOP 10 (120 Members)

OTHER (406 Members)

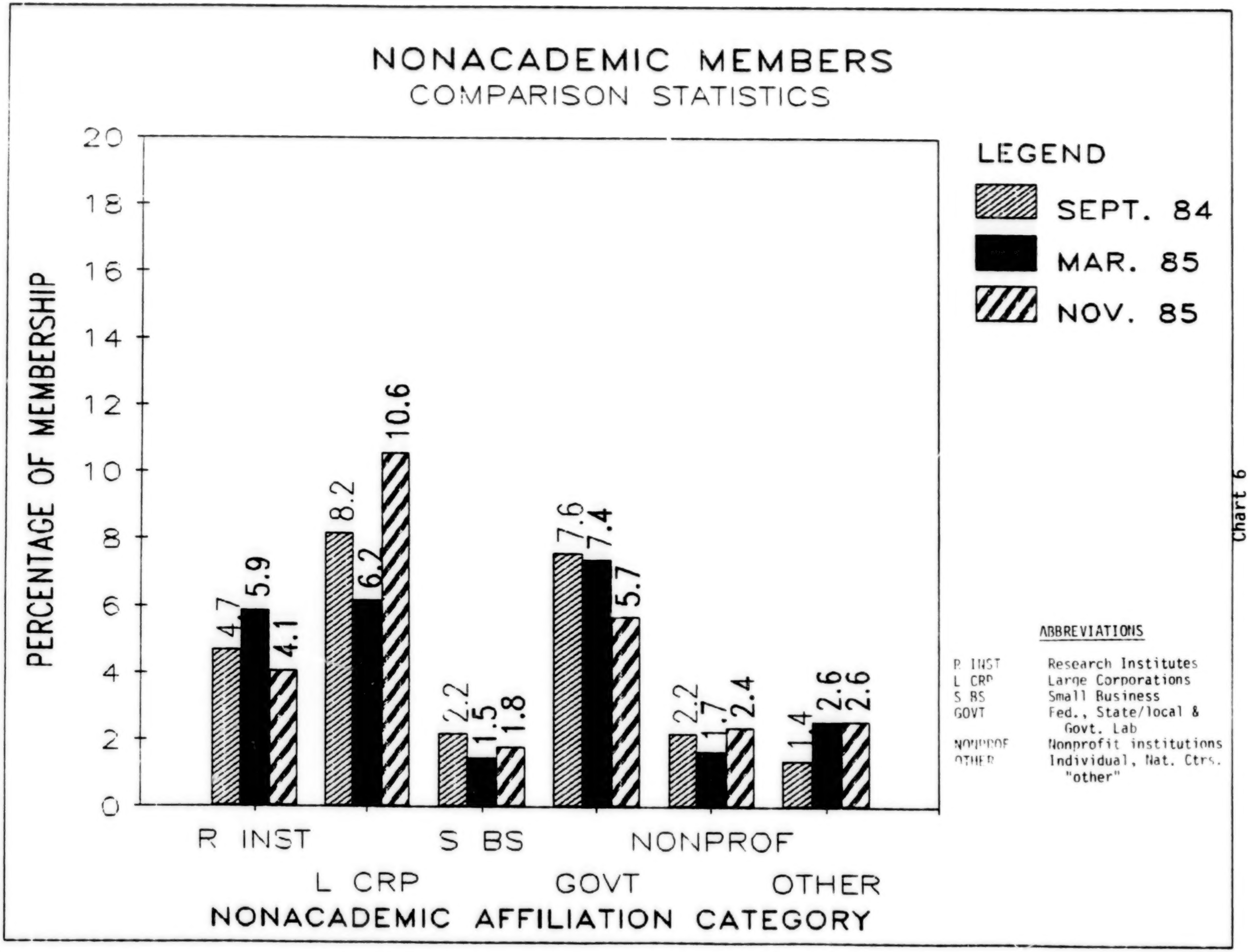
Percentage of 736 Members

O/D	7%
ADM	4
AAEO	13
BBS	42
ENG	15
MPS	10
SEE	3
STIA	6
TOTAL	100%

Distribution of PUI's

O/D	4
ADM	-
AAEO	4
BBS	1
ENG	1
MPS	-
SEE	1
STIA	1
TOTAL	12 Members

Chart 5



NONACADEMIC MEMBERS
COMPARISON STATISTICS

ABBREVIATIONS

R INST	Research Institutes
L CRP	Large Corporations
S BS	Small Business
GOVT	Fed., State/local & Govt. Lab
NONPROF	Nonprofit institutions
OTHER	Individual, Nat. Ctrs. "other"

Chart 6

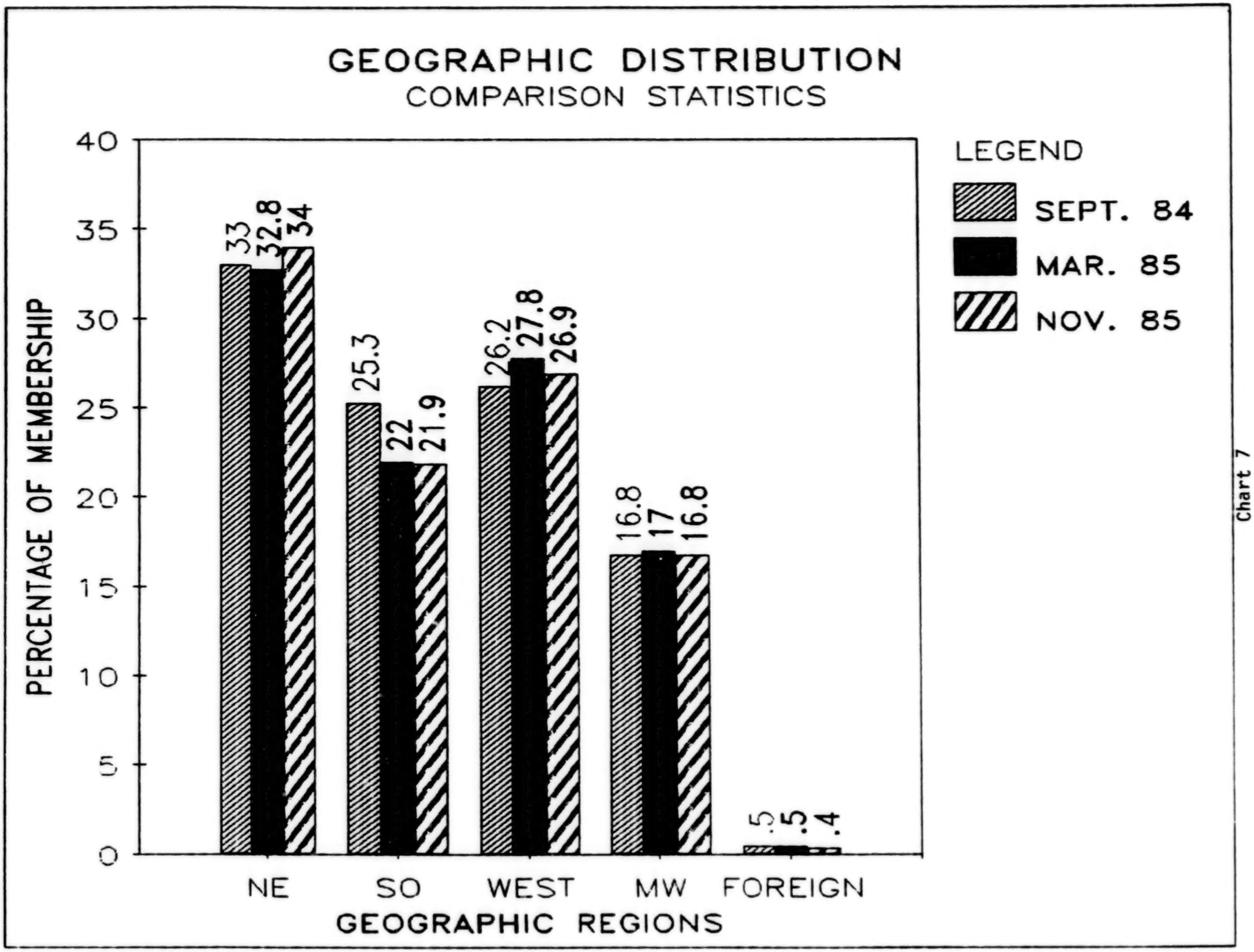

GEOGRAPHIC DISTRIBUTION
COMPARISON STATISTICS
PERCENTAGE OF MEMBERSHIP
0
5
10
15
20
25
30
35
40
33
32.8
34
25.3
22
21.9
26.2
27.8
26.9
16.8
17
16.8
.5
.5
.4
NE
SO
WEST
MW
FOREIGN
GEOGRAPHIC REGIONS
LEGEND
SEPT. 84
MAR. 85
NOV. 85

Chart 7

Office of Audit and Oversight

May 3, 1984

Director, OAO

NSF Reconsiderations — CY 1983

Addressees

Attached for your information is an OAO oversight study for the NSB Committee on Audit and Oversight on NSF Reconsiderations -- CY 1983. No major problems surfaced although there were minor problems involving (1) timeliness of NSF responses and (2) the orderliness of reconsideration documentation.

/s/ Jerome H. Fregeau

Jerome H. Fregeau

Attachment

Addressees:

Dr. Knapp, Director
Dr. Nicholson, Acting Deputy Director
Dr. Bridgewater, Acting Assistant Director/AAEO
Dr. Rabin, Acting Assistant Director/BBS
Dr. Hall, Acting Assistant Director/E
Dr. Bardon, Acting Assistant Director/MPS
Dr. Bautz, Acting Assistant Director/SEE
Mr. Green, Assistant Director/STIA
Mr. Ubois, Assistant Director/A

bcc: Dr. Zwolenik
Mrs. Thomas
CHRON
FILE: NSB/AO-84-15, RECONSIDEATIONS--CY1983 (NSB/AO 29th Meeting—05/10/84).

OAO:JJZ:DFH:05/03/84:357-9458... TAPE #13, #6...

NSB/AO-84-15

April 30, 1984

RECONSIDERATIONS CY 1983

Introduction

Although the NSF permits no formal rebuttal process during the review of a proposal,[1] it has, since January 1976, provided for reconsideration of a declined proposal at three management levels. A principal investigator (PI) whose proposal has been declined may (1) obtain an explanation of the declination from the responsible Program Officer. If this explanation does not satisfy the PI that the proposal was fairly handled and reasonably evaluated, the PI may also (2) obtain reconsideration of the declination by the responsible Assistant Director. If the applicant institution is still not satisfied after reconsideration by the responsible Assistant Director, it may (3) obtain further reconsideration by the Deputy Director of the NSF. If a proposal has been declined following review by the National Science Board, however, only an explanation is available. Details on the reconsideration process are in the attached NSF Circular 127.

Although any explanation given to the PI by a Program Officer is the subject of a diary note in the proposal jacket, there are no NSF-wide data reported on this level of reconsideration.[2] However, each directorate must record all requests for reconsideration by the Assistant Director as specified in section 5 of NSF Circular 127 and forward these records quarterly to the NSF Deputy Director. The Office of the Deputy Director maintains similar records on requests it receives for further reconsideration from applicant institutions.

As part of its oversight activities, OAO reviewed the quarterly reports of each directorate and of the Office of the Deputy Director for CY 1983. It also reviewed the document record in a sample of the proposal jackets for which there were requests to the Assistant Directors for reconsideration. No major problems were found. However, timeliness in furnishing the results of the reconsideration process and the orderly maintainence of reconsideration records in jackets are minor problems worthy of corrective attention.

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[1] However, the Program Officer can ask for additional information, response to reviewer comments, etc. if needed to make a decision.

[2] Anecdotal information indicates that the most popular method for reversing a declination is submission of a new proposal which takes account of information and criticism obtained from discussion with the Program Officer and from anonymous verbatim peer reviews.

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Statistical Data

In CY 1983, Assistant Directors reconsidered 44 declinations distributed:

AAEO	4
BBS	5
ENG	7
MPS	24
SEE	0
STIA	4

These 44 are 0.4% of the 10,168 proposals NSF declined in CY 1983.

In all completed reconsiderations except one, the declination was upheld. The Acting Assistant Director/BBS reversed one declination.

Four of these 44 were further reconsidered by the Office of the Deputy Director who upheld the original declination and the Assistant Director's decision to sustain that declination.

Furnishing Results of Reconsideration

NSF Circular 127 requires that those requesting reconsideration from the Assistant Director or from the Deputy Director receive the results of the reconsideration within 30 days.

It was not possible to determine the timeliness of STIA's response to the four requests for reconsideration by the Assistant Director since STIA did not provide the "date of receipt" of each request in its quarterly reports. Future STIA reports should provide the information listed in section 5, NSF Circular 127.

Of the 40 requests to Assistant Directors other than STIA, 50% waited, or were waiting, for the results of the Assistant Director's reconsideration with no interim notification of delay for more than 30 days. Although there was one instance each of 70- and 85-day delays without any interim notification most overdue replies fell in the 30- to 45-day category. Whenever the results of the reconsideration cannot be furnished within 30 days, the cognizant Assistant Director should furnish the PI a written explanation of the need for more time and indicate the date by which the results of the reconsideration can be expected--as required in section 4 of NSF Circular 127.

Of the 4 institutional requests for reconsideration by the Deputy Director, 2 received results within 30 days and 2 within 36 days.

Sample of Jackets Under Reconsideration

OAO reviewed 12 proposal jackets from among the 44 requesting reconsideration by the Assistant Directors. The distribution was:

AAEO - 2
BBS - 1
ENG - 2
MPS - 6
SEE - 0
STIA - 1

Of these 12, 11 declinations were upheld at the Assistant Director's level and 1 declination was reversed by the Acting Assistant Director/BBS. Two MPS declinations that were upheld at the Assistant Director's level appealed to the Deputy Director who sustained the declinations. Both of these were submissions from small companies.

In general, there seems to be confusion in the jacket with respect to reconsideration documents. These are confidential review documents and should be filed chronologically on the left side of the jacket.

In 4 instances the Assistant Director reconsidered without the PI having sought and obtained an explanation from the Program Officer as is normally expected.

Based on the original ratings and reviews found in each of the 12 jackets, it is difficult to understand why approximately 40% requested reconsideration at the Assistant Director level given the obviously low ratings of the reviewers and the current high cutoff levels. It is equally difficult to understand why an even higher percentage requested reconsideration from the Office of the Deputy Director. Leaving aside these cases which are well below the cutoff region, the others appear to have some plausible basis upon which the PI might, if correct, feel that a reversed decision was warranted.

At the Assistant Director level and fully in accord with the requirements of NSF Circular 127, the AD performed the requested reconsideration and/or appointed one or two others not involved with the original evaluation of the declination to perform the reconsideration. The same was true for reconsiderations by the Deputy Director.

The records support quite well the decisions made by the ADs and the Deputy Director.

In general the correspondence furnishing the results of the reconsideration process shows a commendable sensitivity to the situation. In parts of three replies, bold restatements of the basis for declination appear somewhat harsh and/or patronizing, but these are not typical.

Conclusion

Aside from the problems of timeliness and document filing, the reconsideration process introduced into NSF in January 1976 appears to be operating smoothly and effectively, thereby contributing positively to PI and public confidence in the NSF peer review system.

James J Zwolenik
James J. Zwolenik
Senior Staff Associate-Oversight
Office of Audit and Oversight

Attachment: NSF Circular 127

NATIONAL SCIENCE FOUNDATION

Office of the Director
Washington, D.C. 20550

NSF CIRCULAR NO. 127
(Revision No. 2)

GRANTS AND CONTRACTS

August 8, 1980

Subject: **Reconsideration of Proposals Declined or Returned by NSF**

1. **Purpose.** This Circular implements the provisions of Important Notice No. 84, "Reconsideration of Proposals Declined or Returned by the NSF," dated August 8, 1980, which establishes procedures and responsibilities for the reconsideration of proposals for grant assistance declined or returned by NSF. This Circular does not apply to procurements governed by the Federal Property and Administrative Services Act or to applications for fellowships or travel grants.

2. **Cancellation.** This Circular cancels NSF Circular No. 127, Revision No. 1, dated October 2, 1979.

3. **Policy.** Award of NSF assistance is discretionary. Nonetheless, a principal investigator (PI) whose proposal has been declined may obtain an explanation of the declination from the responsible Program Officer. If this explanation does not satisfy the PI that the proposal was fairly handled and reasonably evaluated, the PI may also obtain reconsideration of the declination by the responsible Assistant Director. If the applicant institution is still not satistied after reconsideration by the responsible Assistant Director, it may obtain further reconsideration by the Deputy Director of the NSF. If a proposal has been declined following review by the National Science Board, however, only an explanation will be available. A PI whose proposal has been returned because it is inappropriate for consideration by NSF may also request reconsideration of this determination.

Reconsideration is not an adversary process and no formal hearing is provided. The Foundation cannot assure applicants that reconsideration will result in an award even if error is established in connection with the initial evaluation.

4. **Procedures.**

a. *Explanation by Program Officer.* A PI who wishes information about a declination or returned proposal may request an explanation from the appropriate Program Officer. That may be done by letter, by telephone, or in person. The Program Officer will explain the basis for the declination or the return. On request the Program Officer will provide the PI verbatim copies of peer reviews received on the declination with only the names and other identifying data of the individual reviewers deleted. The Program Officer will afford the PI an opportunity to present the PI's point of view and will take any further action that seems appropriate.

No revisions made to a proposal after declination will be considered in connection with the original proposal. However, a substantially revised proposal may be submitted for review and evaluation as a new proposal under the usual procedures.

b. *Reconsideration by the Assistant Director at the Request of the Principal Investigator.* If dissatisfied with the Program Officer's explanation, the PI may request in writing that the Foundation reconsider its action. Such a request will be considered only if the PI has first sought and obtained an explanation from the Program Officer and only if the request is received by the Foundation within 180 days after the declination or return.

(1) The PI should address the request to the Assistant Director for the Directorate that handled the proposal and should explain why the PI believes that the declination or return was unwarranted.

(2) The Assistant Director will consider the request for reconsideration. The record of the evaluation of the declined proposal will be reviewed to determine whether the declined proposal was fairly handled and reasonably evaluated. The returned proposal will be reviewed to determine whether the proposed research is inappropriate for NSF consideration.

(a) The Assistant Director may request additional information from the PI and may obtain additional peer reviews.

(b) The Assistant Director may conduct the reconsideration personally or may designate another NSF official who had no part in the initial evaluation to do so. As used here, "Assistant Director" includes such a designated official.

(3) Within 30 days after the date of the request, the Assistant Director will furnish the PI in writing the

results of the reconsideration. If results cannot be furnished within 30 days, the Assistant Director will furnish the PI a written explanation of the need for more time, indicating the date when results can be expected. If the Assistant Director reaffirms the declination or return, he or she will inform the PI that the PI's institution may obtain further reconsideration by the Deputy Director.

c. *Further Reconsideration by the Deputy Director at the Request of the Applicant Institution.* Within 180 days after a reconsideration at the Assistant Director level, the applicant institution may obtain further reconsideration by the Deputy Director of the NSF. Only the applicant institution may request further reconsideration by the Deputy Director, except that a PI who submitted a proposal as an individual, without connection with any institution, may submit a request for further reconsideration as an individual.

(1) The institution should address a request for further reconsideration to the Deputy Director of the NSF. The request need not be in any particular format, but it must be in writing and must be signed by the institution's president or other chief executive officer and by the PI. For declinations, it should explain why the institution believes that an error may have occurred in the initial evaluation and why it is not entirely satisfied with the reconsideration by the responsible Assistant Director. For returned proposals, it should explain why the institution believes that an error may have occurred in the initial determination that the proposal was inappropriate for consideration by NSF.

(2) The Deputy Director will review the request for further reconsideration and the record of earlier NSF actions, including the original evaluation of the declined proposal and the reconsideration by the Assistant Director, to determine whether the declined proposal was fairly handled and reasonably evaluated or whether the returned proposal is outside the domain of NSF.

(a) The Deputy Director may request additional information from the PI or the applicant institution and may obtain additional peer reviews.

(b) The Deputy Director may conduct the further reconsideration personally or may designate another NSF official who had no part in the initial evaluation of the proposal or the earlier reconsideration to do so. As used here, "Deputy Director" includes such a designated official.

(3) Within 30 days after a request for further reconsideration is received at the NSF, the Deputy Director will furnish the institution in writing the results of the further reconsideration. If results cannot be furnished within 30 days, the Deputy Director will furnish the institution a written explanation of the need for more time, indicating the date when the results can be expected.

(4) After reconsideration by the Deputy Director, a declination or return will not be reconsidered further. However, a substantially revised proposal may be submitted for review and evaluation as a new proposal under the usual procedures.

5. **Reporting Requirement.** Each directorate will maintain a record of all requests for reconsideration by the Assistant Director. The record should include the date of receipt, the name of the PI, the name of the applicant institution, and the proposal number and title. When the reconsideration is completed, the record should be updated to indicate when the results of the reconsideration were furnished to the PI and what the results were. Within 5 working days after the end of each quarter of the fiscal year, each directorate will forward to the Deputy Director a copy of the record for all requests received and reconsiderations completed during the previous quarter.

The Office of the Deputy Director will maintain similar records on requests for further reconsideration from applicant institutions.

Donald N. Langenberg

Donald N. Langenberg
Acting Director

Distribution E